WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

Interchangeable Parts

SAVE INSTALLATION and MAINTENANCE TIME

WITH **CHAPMAN** *Standardized* **SLUICE GATES**

You'll make faster, easier installations with Chapman's Standard Sluice Gates. Interchangeable stems and couplings assemble quickly in the field — without match-marking.

And you'll save time on maintenance, too. Chapman's interchangeable repair and replacement parts always fit—without struggle or alterations.

Three types of control available—your choice of manual, hydraulic cylinder or motor are designed to give you easy, dependable operation. Learn the full time and money saving facts. Send today for your copy of Chapman's Standard Sluice Gate Handbook.

THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASSACHUSETTS

NEW TYPE STRAIGHT READING METER REGISTER

MANY ADVANTAGES OFFERED

A great many water works men prefer the straight reading or cyclometer type of water meter register due to the ease and accuracy with which it can be read. But the design of straight readers produced in the past has been such that they have frequently proved troublesome and unreliable in service. All these difficulties have now been overcome according to engineers at Rockwell Manufacturing Company, by a revolutionary new register design.

Mechanical Features

In the new Rockwell straight reading register the number wheels are recessed to receive the pinions, thus making it impossible for the pinions to get out of line and bind. The wheels themselves are of heat proof plastic. These wheels are also impervious to corrosive attack. The numerals are impressed in black against a white background to provide good visibility. The dial plate is made of stainless steel with all indications permanently etched into the surface. This stainless steel plate will not chip, crack or discolor.

Easy to Reset

One of the important features of this register design is the ease with which the numerals can be returned to zero. This is desirable when reconditioned meters are put back in service to simplify record keeping during the life of the meter.

To reset the Rockwell register it is only necessary to remove a simple spring clip after which the pinion and number wheel shafts will easily slide through the brackets to return to the zero reading.

Large Red Test Hand

The Rockwell straight reading register is fitted with a large red center test hand that sweeps the entire outer circumference of the dial face. This large hand aids in calibrating meters and detecting small flows. It also may be used to demonstrate leaky fixtures to doubtful consumers.

Any domestic size Rockwell meter (Empire, Arctic or Tropic) can now be furnished with this new straight reading register upon specification. It is also available for parts replacement.

Pittsburgh disc meters are precision built to keep the performance standards that have been so carefully engineered into them. Step by step—from controlled casting . . . through accurate machining and expert fitting—to exacting tests—Pittsburgh disc meters are *made right to measure right!* In addition, the unit assembly of working parts assures a free running mechanism that years hence can be repaired or replaced with minimum trouble and expense. Get all the facts about Rockwell disc meters now. *Write for catalog.*

Rockwell
MANUFACTURING COMPANY
PITTSBURGH 8, PA.
Atlanta Boston Chicago Columbus
Houston Kansas City Los Angeles New York
Pittsburgh San Francisco Seattle Tulsa

Under the Hot Texas Sun

TYLOX Flexible Rubber JOINTS

FIGHT CONTRACTION PREVENT LEAKAGE

Thumb Nail Facts About Lyford's Water Supply Line

LOCATION: Between Lyford, Texas, reservoir and Willacy County Water Control and Improvement District No. 1

PIPE: Over 26,000 feet of 14" unreinforced concrete pipe in 4' lengths. Manufactured by the Valley Concrete Pipe Co., McAllen, Texas

COUPLINGS: TYLOX flexible rubber JOINTS

ENGINEERS: Sigler, Clark and Winston, Weslaco, Texas

CONTRACTOR: F. M. Reising Construction Company, Edinburg, Texas

Making Joints with
TYLOX RUBBER GASKETS
Is as simple as
ABC

Lubricate sliding surfaces with Tylox Cement.

Cement tongue and snap on Tylox gasket.

Shove the pipe home.

Lay pipe under the broiling summer sun in Texas — run cold water through the line — and you get serious leakage from the contracted joints. That was the problem facing the engineers on the Lyford, Texas, water supply line. And, they answered it with TYLOX, the flexible rubber joint that makes lines leakproof for life!

Using TYLOX Gaskets, the contractors on the job "did not experience a single leak" — despite the extreme contraction that resulted when cold water hit the hot line. What's more, the installation was simple and fast — averaged over 1000 feet per day with a minimum number of men.

You, too, can stop leakage, or infiltration, quickly, effectively and inexpensively with the positive, enduring seal of a TYLOX rubber joint. More than 200,000 miles of pipe and up to 60 years of known service life support your use of rubber couplings.

Solve that next, tough "pipeline problem" with TYLOX RUBBER JOINTS!

Write, wire, or phone for Specification Data and Literature on TYLOX Gaskets.

HAMILTON KENT
MANUFACTURING CO.
KENT, OHIO
225 Gougler Ave. Tel. 3449

"THE ONLY PERMANENTLY TIGHT LINES ARE LAID WITH RUBBER JOINTS"

WATER AND SEWAGE WORKS. Reg. U. S. Patent Off. Published monthly by Gillette Publishing Co., at 404 North Wesley Ave., Mount Morris, Ill. Entered as second class matter Mar. 4, 1948, at the post office at Mount Morris, Ill., under Act of Mar. 3, 1879. For subscription rates, see Contents Page.

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

COMING ARTICLES

"A Revolutionary Sewage Treatment Plant" being tested at Rockford, Ill., will be described by Riedesel and Hansen . . . "Modern Chlorine Handling Facilities" in Richmond, Va.'s new filtration plant will be described by H. E. Lordley . . . "Pollution Abatement Attainments" of the American Maize Prod. Co., as related by Van Patten and McIntosh, comprises another story of tackling pollution problems within the plant, and another demonstration of waste curtailment that pays off . . . "Ground Water Contamination by Chromium Wastes," from Messrs. Davids and Lieber, reports a revealing study of vitiation of ground water supplies by chromium wastes disposed of in leaching ponds . . . "Newark's Veterans" by Lawrie Leedom is an interesting description of America's oldest custom-built Venturi meters now being retired after almost 60 years of continuous service . . .

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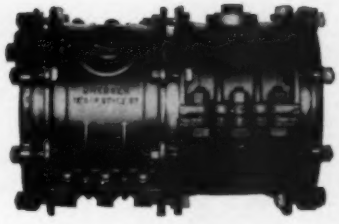
(Member—Audit Bureau of Circulation and Associated Business Publications, Inc.)

ench . . . ten minutes

When winter breaks occ[illegible] ready to make quick, *permanent* repairs wit[illegible] Dresser "Adjustable" Repair Sleeve, Style 82. Re[illegible] less of weather, one man, using only a wrench, can repair a break or split in a matter of minutes. Interchangeable sections make these "pre-packed" repair sleeves adjustable to exact fit on all classes of AWWA pipe, and the specially compounded rubber gaskets introduce flexibility into your line.

The *low price* of the Style 82 offers genuine economy. Order now—to be sure you have a supply on hand for emergency repairs this winter. For CIP from 4″ to 8″ in diameter.



FOR LONGER SPLITS, LARGER SIZES

Dresser Split Sleeve, Style 57C, used singly or in combination (as shown above), encloses breaks, holes, splits in CIP longer than the Style 82 will accommodate. Available in sizes through 12″.

DRESSER "ADJUSTABLE" REPAIR SLEEVES

Dresser Manufacturing Division (One of the Dresser Industries), 59 Fisher Ave., Bradford, Pennsylvania • In Texas: 1121 Rothwell St., Houston. In Canada: Dresser Manufacturing Co., Ltd., Toronto • Sales Offices: New York, Chicago, Houston, San Francisco

Fluoridation News

1945 1951

IN TEXAS, TOO—

CITY OF MARSHALL

MARSHALL, TEXAS

January 24th, 1951

Wallace & Tiernan Co. Inc.
1112 National City Bldg.
Dallas 1, Texas

Gentlemen:

The City of Marshall, Texas began fluoridation of its municipal water supply in the Spring of 1946, under the jurisdiction of the Texas State Health Department. Marshall was the first city in the State of Texas to use fluoridation.

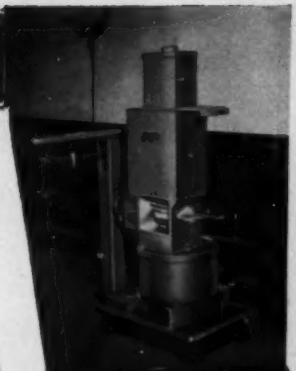
In February 1950, we changed our method of fluoridation by feeding sodium fluoride with a Wallace & Tiernan Type NA Dry Chemical Feeder.

We have found the Wallace & Tiernan Type NA Feeder to be simple in operation, easy to adjust and maintain, and extremely accurate for feeding sodium fluoride. We have been able to hold the fluoride content of our treated water very constant by using this feeder.

We would be glad to recommend this feeder to any town considering adding fluorides to the public water supply.

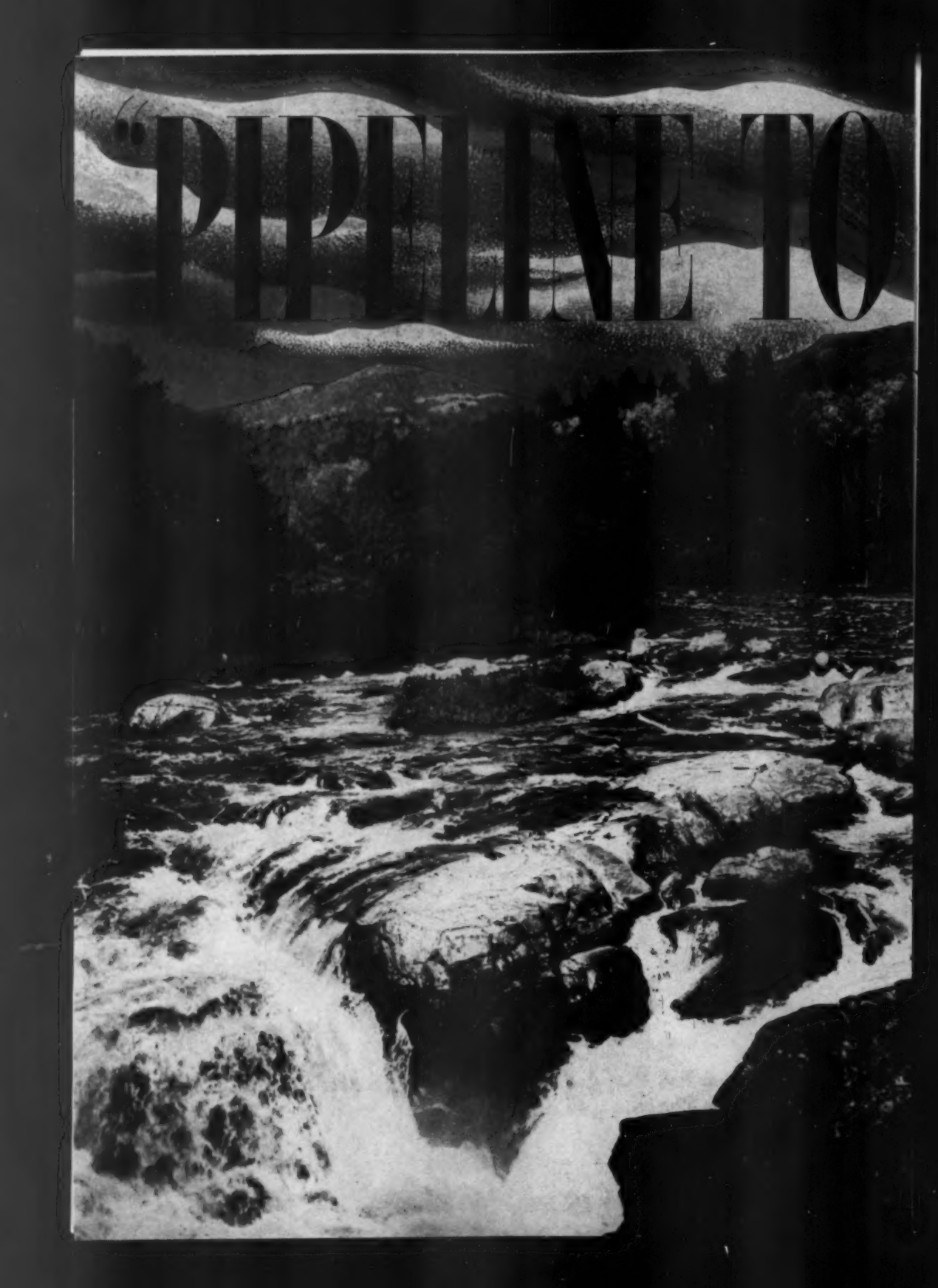
Very truly yours,

CITY OF MARSHALL,
J. W. Schonhardt
J. W. SCHONHARDT
Water Superintendent



When *your* community is ready to look into fluoridation — and after you have consulted your State Department of Health — you'll find W&T Engineers ready and willing to help you.

WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES


"PIPELINE TO

THE CLOUDS"

. . . a dramatic new color movie—part of a stimulating package program that dramatizes the need for an adequate water supply in your community

PLANNING—Emphasizes the importance of planning in improving water works. All community-action groups and leaders should see this film.

To aid water works executives in developing that most priceless asset—an informed public—General Electric has developed a non-commercial, unbiased packaged program. Endorsed by the American Water Works Association and U. S. Public Health Service, it is an extension of G.E.'s More Power to America activity and consists of:

- a 16-mm, 25-minute color movie that forcefully dramatizes how your community's social, business and industrial life depends on plenty of good water,
- a comprehensive, 40-page manual that gives result-getting suggestions on how to enlist public support for water-improvement programs in your community, and
- handouts highlighting important points of the film, for use at public showings.

More information about the G-E Water-Supply Program is available to any individual who is influential in developing his community's water system. *General Electric Company, Schenectady 5, N. Y.*

BEHIND-THE-SCENES—Shows the people of your community the many unseen operations necessary to assure them plenty of good, safe water.

SHORTAGE PREVENTION—Use the film to impress on civic leaders that "ten years from today is now in the water-supply business."

write today

A *free* copy of the manual, and further details about the Program, will be sent you if you request them on your letterhead. This helpful manual shows *why* you may need a new survey of your water system. It tells *how* to interpret your proposal, based on a survey, to the public. And then it describes *what* you must do, using examples from other communities, to gain public support. Write today for GEA-5555 to Sect. 666-67, General Electric Company, Schenectady, N. Y.

DON'T DELAY! WRITE NOW FOR YOUR COPY!

More Power to America

GENERAL ELECTRIC

666-67

Here's the Key to...

√ Lower Treating Costs

√ Higher Plant Efficiency

√ Important Savings in Chemicals

in both small and large plants

BECKMAN pH CONTROL

THE BECKMAN MODEL H-2 pH METER is one of a complete range of Beckman pH Meters available for every type of application*. The H-2 is particularly recommended for applications where high accuracy and simple operation—combined with the convenience and low cost of 115-v. AC operation—are desired.

It provides instant and direct pH readings, and a simple, built-in dial permits quick, convenient temperature compensation over the entire range of 0° to 100°C (32° to 212° F.). High reading accuracy is assured by wide-spread dual range scale that reads from 0 to 8 pH or from 6 to 14 pH at the turn of a switch. Same switch also provides instant millivolt readings from 0 to ±800 mv and from ±600 to ±1400 mv for titrations and oxidation-reduction measurements.

Built-in electrode support and compact case design save valuable space and permit easy portability to various plant locations.

Particularly important is the wide range of factory-sealed, maintenance-free Beckman Glass Electrodes available for use with this instrument . . . electrodes that are virtually unbreakable . . . that cover extreme temperature ranges from below freezing to above boiling . . . that have an unprecedented pH range with negligible errors . . . that are abrasion-resistant and chemically durable to a degree never before thought possible in glass electrodes.

*In addition to the H-2 Meter, other Beckman pH equipment includes completely automatic pH indication and control instruments for large-scale process applications . . . battery-operated models for complete portability in plant and field use . . . and a laboratory type instrument that features maximum versatility and accuracy for research and laboratory applications

Regardless of whether your plant is large or small . . . regardless of whether you are building a new plant, modernizing present equipment or making the most of what you now have, remember this—**no water or sewage plant is completely modern without Beckman pH Control!**

IN SEWAGE TREATING OPERATIONS and industrial waste disposal, accurate pH control is essential for optimum sludge digestion, for minimizing odor, for obtaining maximum settling and filtration, for assuring proper clarification and neutralization of effluent before discharge into rivers—all at lower chemical costs and greater plant efficiency.

IN WATER TREATING OPERATIONS accurate pH control is important in every one of the major treating steps. Each *Coagulation* process has its own narrow pH limit at which maximum floc and settling rate occur. In *Softening*—whether lime-soda, zeolite or organic ion exchange—optimum results can be obtained only with modern pH control. In *Neutralization*, accurate pH control is essential to regulate the process to changes in pH of the incoming water and to insure a neutral finished water that minimizes corrosion in mains, pipe lines and industrial operations.

Do you have a copy of this informative booklet?

It contains a great deal of helpful data on the application of pH control to modern water and sewage processes and discusses the various methods used. Your authorized Beckman dealer will be glad to supply you with a copy and to give any assistance you may wish in the application of pH control to your particular operations. Or write direct.

BECKMAN INSTRUMENTS
control modern industries

BECKMAN INSTRUMENTS, INC.
SOUTH PASADENA 20, CALIF.
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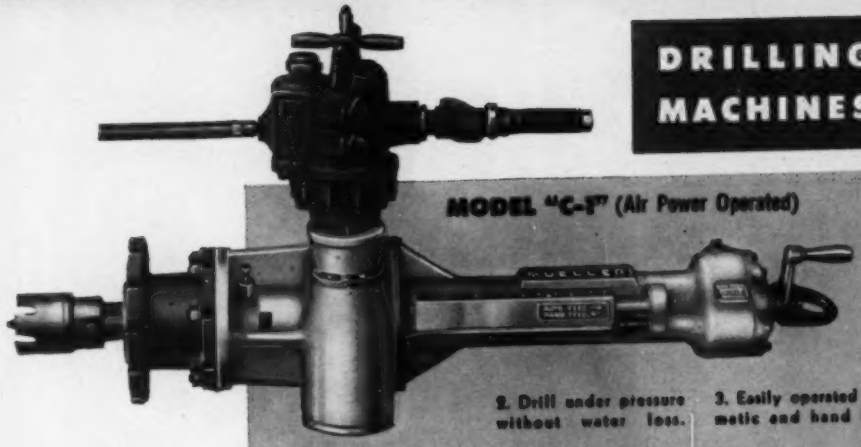
MUELLER®

DRILLING MACHINES



MODEL "C-1" (Air Power Operated)

1. Cut holes from 2 to 12 inches in any size main.

2. Drill under pressure without water loss.

3. Easily operated automatic and hand feed.

*STANDARDIZE

MODEL "C-C" (Hand Operated)

4. Ruggedly built with extra-large safety factor.

5. Telescoping vital working parts for compactness.

6. Backed by 94 years of engineering experience.

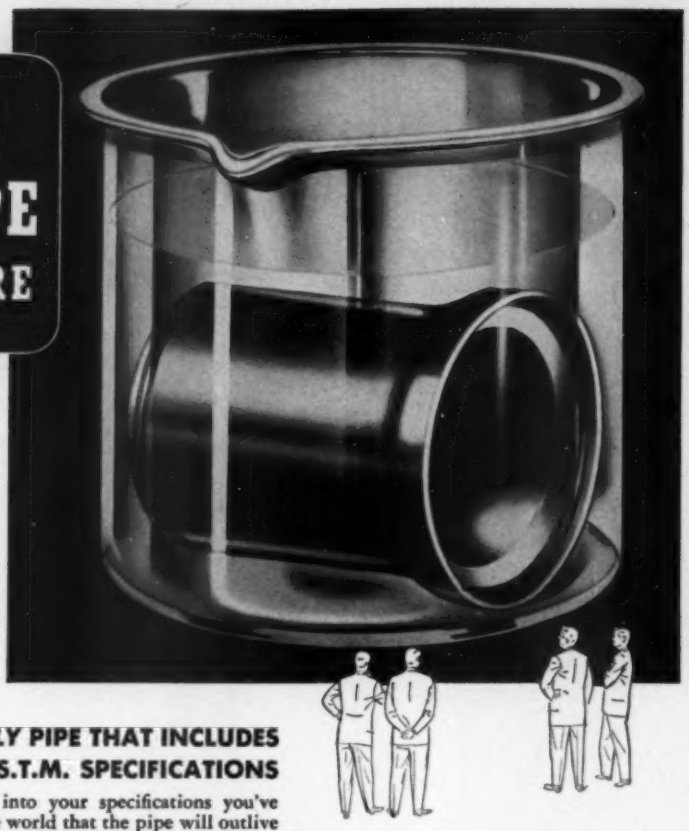
MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

*Yes, *standardize* on Mueller Drilling Machines because of their sturdiness, versatility, and simple trouble-free operation. *Standardize*, too, on the wide variety of other Mueller products especially designed for the industry. Consult your Mueller "H" Catalog or write for additional information.

SPECIFY CLAY PIPE AND BE SURE



CLAY PIPE IS THE *ONLY* PIPE THAT INCLUDES ACID TESTS IN ITS A.S.T.M. SPECIFICATIONS

When you write Clay Pipe into your specifications you've given the best guarantee in the world that the pipe will outlive for years, and even centuries, the investment in the project. The clay itself is chemically inert. By the Clay Pipe Industry's exclusive process of VITRIFICATION, the material is fired and bonded together into the only pipe known that maintains its resistance to corrosion forever. In addition to these basic, unmatched qualities, careful controls over each operation give you denser, stronger, better Clay Pipe — of *uniformly* high quality. You can specify Clay Pipe with confidence, secure in the knowledge that Clay Pipe does not disintegrate from acid attack — that it *never wears out.*

NATIONAL CLAY PIPE MANUFACTURERS, INC.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
206 Connally Bldg., Atlanta 3, Ga.
703 Ninth & Hill Bldg., Los Angeles 15, Calif.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio

SPECIFY *Vitrified* CLAY PIPE

WRITE FOR DETAILED INFORMATION

Additional information and data on Vitrified Clay Pipe, Wall Coping and Clay Flue Lining sent FREE on request. State your specific questions. Simply contact the regional office nearest you.

C-451-1

NOW! A NEW PLAN...*

The only COMMUNITY-WIDE GARBAGE GRINDER PLAN that works!

Mr. Arthur Pickett, Deputy County Engineer of Los Angeles County and a national authority, in the January, 1951 issue of the American City Magazine, proposed a sound and unbiased Community Plan for the installation of garbage grinders. We sincerely urge all Public Officials to consider the merits of this plan, as it is designed to meet their most discriminating requirements.

what the workable community-wide plan means to your community!

It is on record with the U. S. Public Health Service (Report No. 15, Vol. 63) that practically every community in the United States has a serious garbage problem. This problem affects the health of the community and is becoming most costly to solve with present garbage removal methods.

The antiquated methods of collecting garbage can be changed for the more practical, sanitary and economical method . . . the garbage grinder method that eliminates garbage at the point of origin . . . right at the kitchen sink in the home, restaurant and public institution.

GREATER HEALTH AND SANITATION

With this new, proven garbage disposing method, every home, public and commercial food-preparing establishment, *the entire community itself*, will be free of the very existence of garbage *forever!*

NO ATTRACTION FOR FLIES, RATS OR VERMIN.

NO OFFENSIVE GARBAGE ODORS.

NO UNSIGHTLY, SPACE-CONSUMING GARBAGE PAILS IN THE ALLEYS, BACKYARDS OR STREETS.

NO GARBAGE COLLECTION, LOWER COSTS

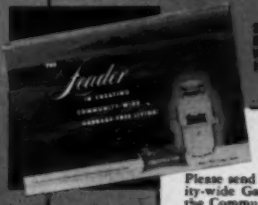
Another important advantage of a Community-wide Garbage Grinder Plan is its saving in labor and equipment. There's no garbage to collect, therefore, the costs in buying and maintaining equipment are drastically reduced to the bare requirements needed to collect rubbish only.

THE COMMUNITY BENEFITS WHEN EVERYONE COOPERATES...

THE COMMUNITY-WIDE PLAN OFFERS 100% COOPERATION

The Public Official is relieved of the grievous and burdensome liability of financing and selecting garbage grinders. In all true analysis, the garbage grinder becomes the private property of the landowner, upon whose shoulders this responsibility would rest.

WE INVITE ALL PUBLIC OFFICIALS TO INVESTIGATE OUR COMMUNITY-WIDE GARBAGE GRINDER PLAN BY WRITING FOR THE COMPLETE PLAN IN DETAIL.



SEND FOR DESCRIPTIVE BOOKLET "COMMUNITY-WIDE GARBAGE-FREE LIVING." No obligation!

Waste King
KITCHEN
PULVERATOR
CONTINUOUS FEED

GIVEN MANUFACTURING CO., LOS ANGELES, CALIF.

Dept. WS10, Given Manufacturing Co.
1250 Wilshire Blvd.,
Los Angeles 17, Calif.

Please send my complimentary copy of "Community-wide Garbage-free Living." I am interested in the Community-wide Garbage Grinder Plan.

Name_____

Title_____ Dept._____

Address_____

City_____ State_____

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● UNRESTRICTED SLUDGE FLOW

The problem of sludge-jammed valves quickly becomes a memory, when a.c.f. CYLINDRICAL Lubricated Plug Valves are used. The full pipe area port through the valve does not retard the flow... the passage is streamlined...the CYLINDRICAL plug shears tough, stringy solids cleanly. Sewage Disposal Engineers and Plants are rapidly standardizing on a.c.f. for all sludge lines!

a.c.f. CYLINDRICAL FULL PIPE AREA **PLUG VALVES**

Representatives in 50 principal cities

Write for Catalog 4-WS, American Car and Foundry Company, Valve Division, 1501 East Ferry Avenue, Detroit 11, Michigan

New York's City Hall, completed in 1811, as it looked 100 years ago

The City of New York has several cast iron water mains in service that were laid more than a century ago. They are part of approximately 5,000 miles of cast iron mains representing about 98% of all the pipe in New York's distribution system. The contrast in traffic and construction, above and underground, today and 100 years ago, is fantastic. Yet the shock-strength, crushing-strength and beam-strength of cast iron mains have enabled them to withstand the unforeseen stresses imposed by vast changes. Because of these strength factors and effective resistance to corrosion, cast iron water and gas mains laid over 100 years ago, are still serving in the streets of 38 cities in the United States and Canada.

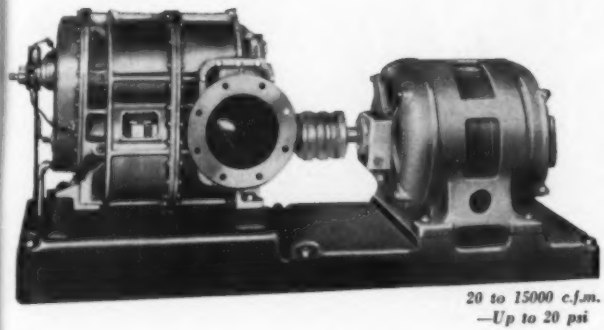
United States Pipe and Foundry Company, General Offices, Burlington, N. J. Plants and Sales Offices Throughout the U. S. A.

U.S. PIPE

NUMBER TEN OF A SERIES

Specify Chicago Air *for the*

CHICAGO Air Diffusion Systems provide complete equipment for sewage aeration. All equipment necessary, from air to water, is specifically designed and engineered as a unit to treat sewage and industrial wastes. One supplier—one responsibility—assures many advantages to the engineer and operator.



20 to 15000 c.f.m.
—Up to 20 psi

Efficient
•
Quiet
•
Compact

Chicago Standardaire Blower

QUIET OPERATION No clatter or pounding. Sound level comparable to centrifugal blower.

LASTING EFFICIENCY Greater adiabatic efficiency allows lower applied horse power for most ratings. Maintains original efficiency as verified by continuous quiet operation.

CUTS COST OF INSTALLATION Quiet operation permits elimination of blower room in many instances.

COMPACT Less layout area than other positive displacement blowers of equal capacity.

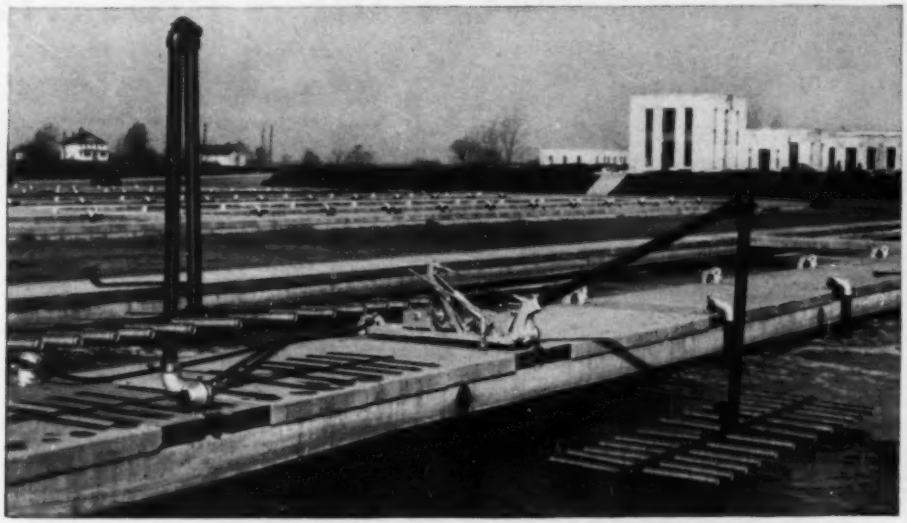
SIMPLIFIED MAINTENANCE Non-wearing oil seals do not require maintenance or replacement. No wear on moving parts with clean air.

DESIGNED FOR LONG LIFE Precision materials and select materials insure long life under continuous operation.

CHICAGO
SEWAGE
EQUIPMENT

Diffusion Systems

Activated Sludge Process



Chicago Swing Diffusers and Precision Tubes

•

Continuous Operation at Low Cost

•

Continuous operation of an aeration battery is possible only with Chicago Swing Diffusers. No stand-by tanks are necessary. Chicago Precision Diffuser Tubes permit the most economical operation of an aeration battery. Swing Diffusers have been installed in over 200 plants since 1937.

1. Low first cost—no standby tanks.
2. Continuous operation at maximum efficiency.
3. Economical—less power used—less labor.
4. Tubes easily and economically cleaned.

Visit our Exhibit at the
F. S. I. W. A.
CONVENTION
October 8-11
Municipal Auditorium
St. Paul, Minnesota

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

2300 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**

Flush Kleen, Serv-Feller, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units. Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

A Marathon Runner...like Cast Iron Pipe...has

To run 26 miles over hill and dale in 2½ hours requires strength and endurance,—in a word, *stamina!* To carry on for 100 years or more, as cast iron water and gas mains are still doing in 38 American cities, also requires stamina. These rugged mains, installed in the days of horse-drawn vehicles, are now withstanding the traffic-shock of multi-ton trucks and buses and the soil disturbances caused over the years by underground construction of sewers, power lines, telephone conduits and subways. Yet cast iron pipe has survived these changes because of its crushing-strength, shock-strength and beam-strength.

No pipe deficient in these strength-factors of long life should ever be laid in paved streets of cities, towns and villages.

CAST IRON PIPE

STAMINA!*

*The Marathon race, blue-ribbon event of the modern Olympic Games (first held in Athens, Greece in 1896) was won in the record time of 2 hours 29 minutes 19.2 seconds in 1936.

CAST IRON

CAST IRON PIPE RESEARCH ASSOCIATION; THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

SERVES FOR CENTURIES

Worth its weight

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

. . . in installation savings

Are you finding it increasingly difficult, in the face of today's economy, to undertake needed water-line construction?

If so, you may find—as other planners do—that Transite* Pressure Pipe can help provide a practical answer to your problem. For this pipe, in addition to its continuing, long-term savings, offers an opportunity for economies in installation *that may go far in helping you contend with rising costs and manpower shortages.*

Transite Pressure Pipe offers a combination of advantages which speed and facilitate water main installations all along the line—from the time the pipe is first received, to final placement of the line in service and restoration of normal street traffic. Not only do pipe laying crews find this modern pipe easy to work with, but its unique features make for a more compact, efficient and economical operation in virtually all the construction phases of water-line extension projects.

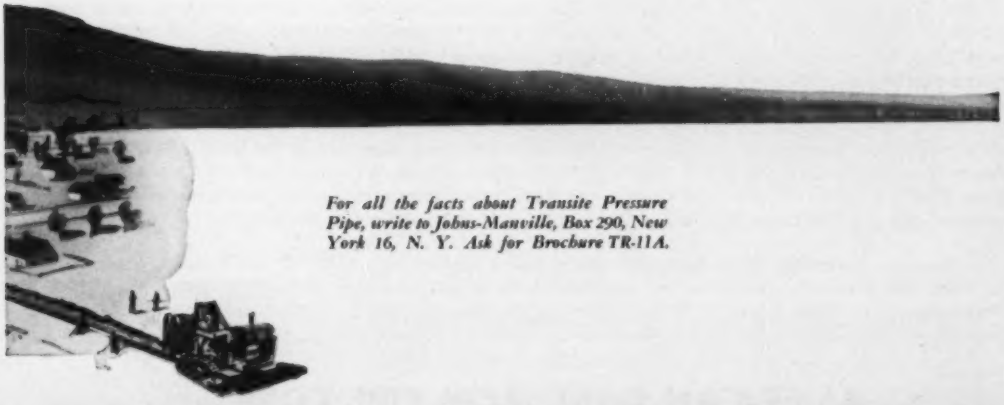
Economies start as soon as a shipment of Transite Pipe is received. Because it is light in weight, unloading and other handling operations are simplified. More footage can be carried per truckload, trucking costs are lowered, and distribution on the job site is faster. And except for the larger diameters of pipe, the sections can be lowered into the trench by hand, or with the aid of rope slings.

Assembly, too, is both rapid and economical. The flexibility of Transite's joints permit the pipe to be laid around wide curves without the need for special fittings. The Simplex Couplings require no calking or hot compounds; they are quickly and easily assembled to provide lastingly tight joints. *And with this pipe you can check for proper assembly immediately after the pipe ends are joined.*

Makes pipe-laying an assembly-line operation

This combined feature of rapid assembly and assurance of joint-tightness as fast as the line is laid, is the key to an important Transite advantage: it means that trench excavation, pipe laying, and backfilling operations can follow in quick succession—often under the supervision of one foreman. It makes pipe-laying virtually an assembly-line operation in which the trench can be closed in a minimum of time. This assures more economical use of excavation and earth handling equipment, reduces the expense and hazards of long stretches of open trench, and helps button-up the job with the least possible expenditure of time, labor and money.

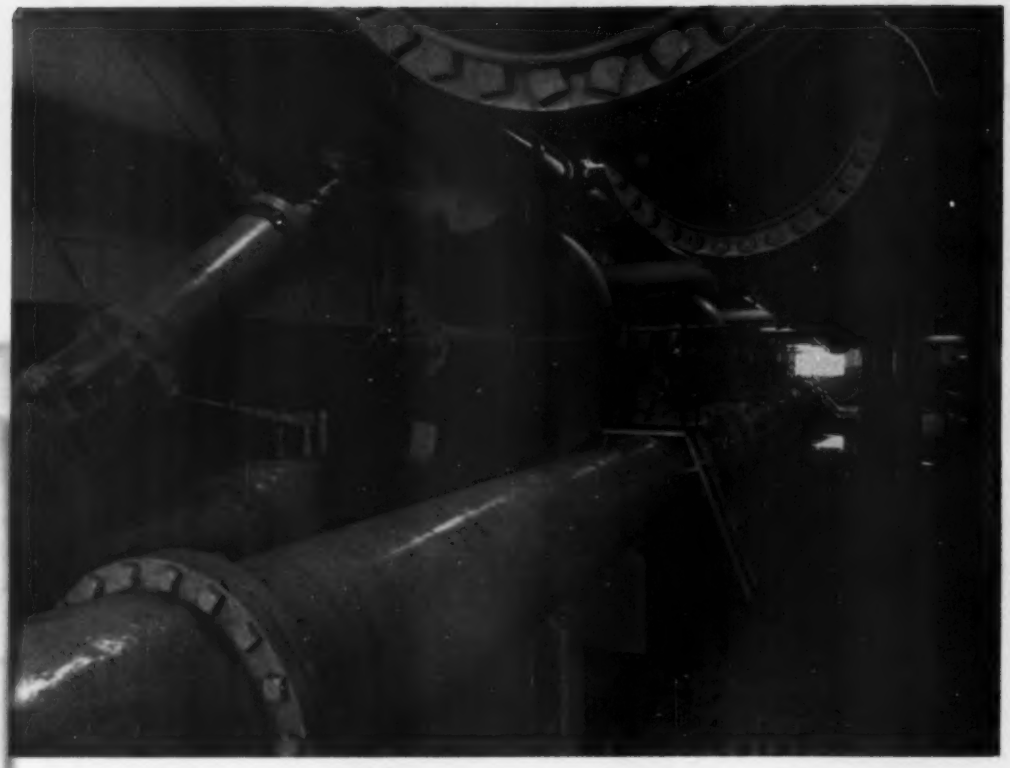
These *initial* savings . . . plus the *long term* economies that have been effected in thousands of installations . . . are two good reasons why you should have the complete story about this modern asbestos-cement pipe developed and produced by Johns-Manville to carry water more efficiently and more economically.



For all the facts about Transite Pressure Pipe, write to Johns-Manville, Box 290, New York 16, N. Y. Ask for Brochure TR-11A.

TRANSITE PRESSURE PIPE

*Transite is a registered Johns-Manville trade mark



MONO-CAST Pipe For Every Service Condition

"Mono-Cast" is the trade name for ACIPCO pipe cast centrifugally in sand-lined molds. Uniform metal section, high physical strength, endurance, and freedom from inclusions are salient properties which have established the name "Mono-Cast" as synonymous with "highest quality cast iron pipe." It can be supplied with joints for conveying water, gas, oil, gasoline, sewage, salt brine, ashes—and in fact, just about everything that a pipe line can conceivably convey.

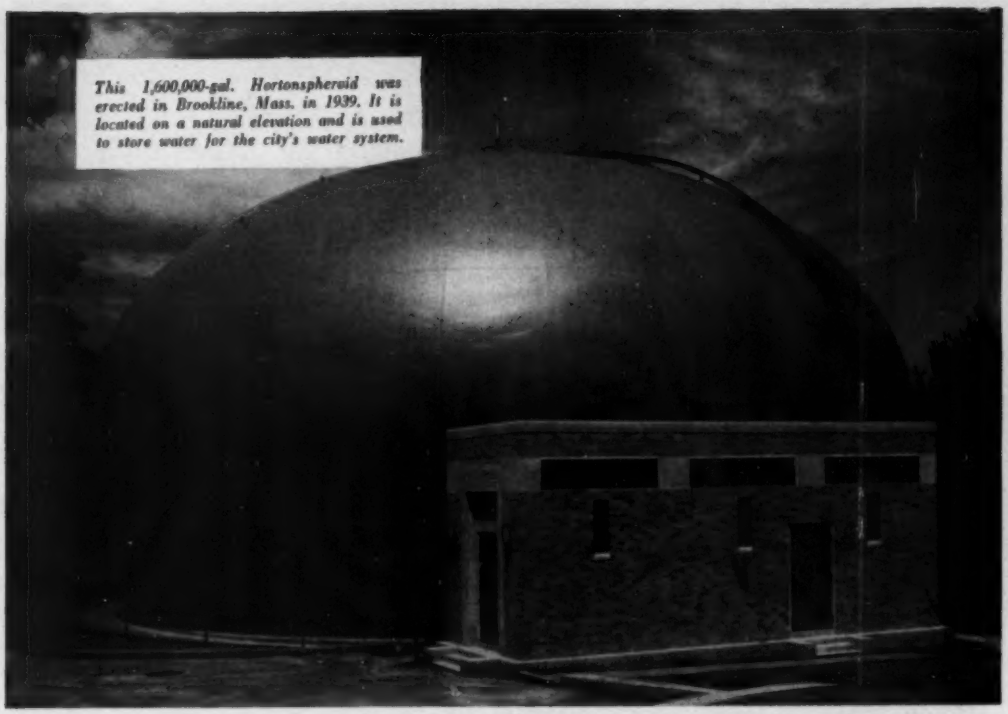
Being cast iron, Mono-Cast Pipe enjoys an enviable reputation. Cast iron pipe has had over three hundred years of service abroad and more than one hundred years of service in the United States. It is satisfactorily serving in locations where especially severe external and internal corrosion conditions exist. Mono-Cast Pipe is designed to give super-service; and its wide acceptance and splendid performance bespeak its excellence and the confidence and esteem in which it is held by those who are using it.

Since the beginning of our Company, nearly half a century ago, ACIPCO has constantly worked hand in hand with engineers, contractors and superintendents in solving piping problems in their respective fields. Refer your next piping job to ACIPCO, and utilize the extensive manufacturing facilities of the largest individual cast iron pipe foundry in America.

AMERICAN CAST IRON PIPE COMPANY

Birmingham 2, Alabama

Dallas Houston El Paso Pittsburgh Kansas City New York City
Chicago Minneapolis Cleveland Los Angeles San Francisco Seattle



This 1,600,000-gal. Hortonspheroid was erected in Brookline, Mass. in 1939. It is located on a natural elevation and is used to store water for the city's water system.

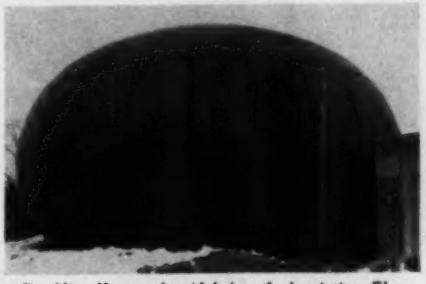
Tank economies begin with the PHOSCOTE PROCESS

The Phoscote Process is a proven method of cleaning and preparing the surfaces of steel plates and shapes before erection. It removes mill scale from steel and provides a better bond between paint and metal.

Plates for this Hortonspheroid in Brookline, Mass., were first dipped into a hot sulphuric acid bath to remove mill scale. Then a clear water rinse removed residual sulphates from the surface of the steel. Finally a hot phosphoric acid bath deposited a thin coat of iron phosphate on the plates. While the metal was still warm, a prime coat of paint was applied to protect the cleaned surfaces.

Field inspections of many Horton installations throughout the country indicate that steel treated by the Phoscote Process does not corrode as fast as the plates in tanks built of untreated steel—and the paint lasts much longer. This results in lower maintenance costs and increased tank life.

When you order Horton steel structures, be sure to specify the Phoscote Process.



Brookline Hortonspheroid before final painting. The unpainted edges of the plates along the seams and the abraded spots were given a patch coat of priming paint before the final coats were applied.

HORTON

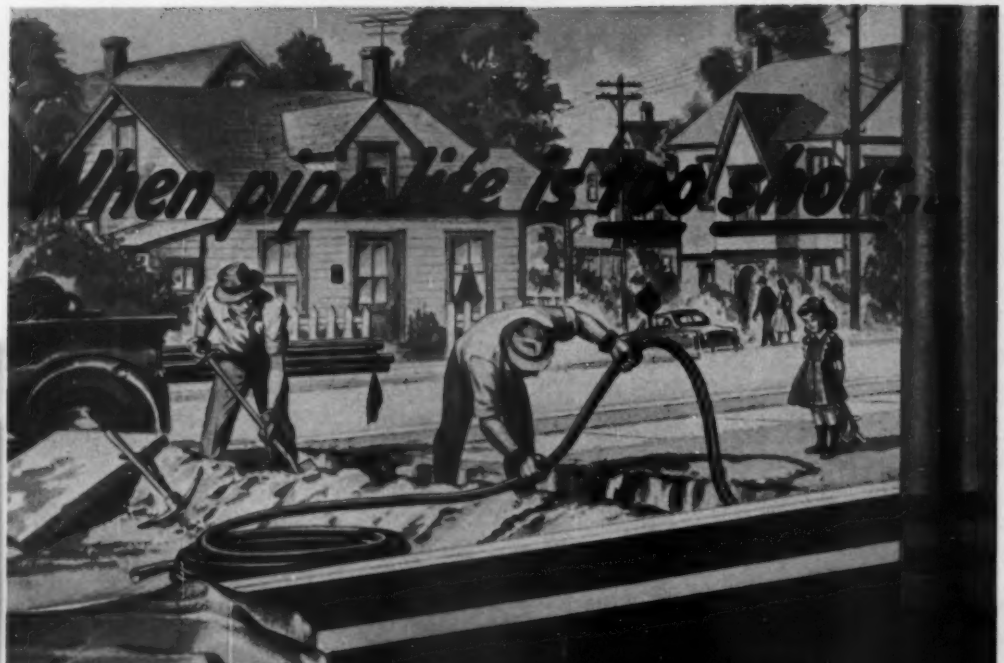
WELDED STEEL

STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3	2181 Healey Building	Los Angeles 14	1555 General Petroleum Building
Birmingham 1	1526 North Fiftieth Street	New York 6	3390-165 Broadway Building
Boston 10	1040-201 Devonshire Street	Philadelphia 3	1646-1700 Walnut Street Building
Chicago 4	2198 McCormick Building	Salt Lake City 4	560 West 17th South Street
Cleveland 15	2262 Guildhall Building	San Francisco 4	1583-200 Bush Street
Detroit 26	1551 Lafayette Building	Seattle 1	1350 Henry Building
Havana	402 Abreu Building	Tulsa 3	1646 Hunt Building
Houston 2	2115 National Standard Building	Washington 6, D.C.	1109 Cafritz Building



SPECIFY CARLON PLASTIC PIPE!

Costly, periodic replacement of water lines because of electrolytic corrosion or interior build-up is reduced to minimum when CARLON plastic pipe is installed. This new pipe is guaranteed against rot, rust and electrolytic corrosion, and its smooth internal surface will not accumulate rust or scale. CARLON pipe assures permanent free flow and features a trouble-free service life many times longer than ordinary pipe.

CARLON pipe service line installations can be accomplished quickly and easily because of its extreme light weight. Flexible types, furnished in long lengths, require fewer fittings per installation and can be curved to follow ditch line or structural contour. Rigid CARLON is supplied in threaded and coupled random 21-foot lengths. In addition, a complete line of plastic fittings incorporating standard I.P.T. is available for connecting both types of CARLON plastic pipe to established systems. Complete adaptation from corporation stops to CARLON pipe is provided through standard adapters.

Remember, for longer pipe life, specify CARLON . . . THE FIRST REAL PIPE THAT IS PLASTIC!

At present, raw material shortages are limiting the production of certain types of CARLON pipe. Every effort is being made, however, to overcome this problem and to meet the growing demand and need for CARLON plastic pipe.

CARLON CP

CARLON PRODUCTS CORPORATION

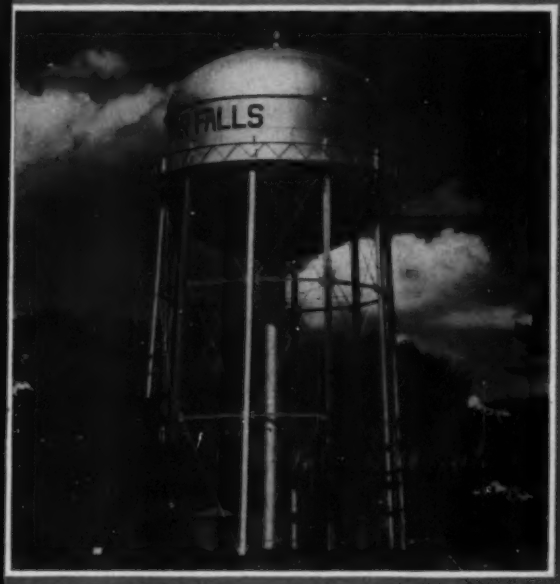
IN CANADA MICRO PLASTICS, LTD ACTON ONTARIO

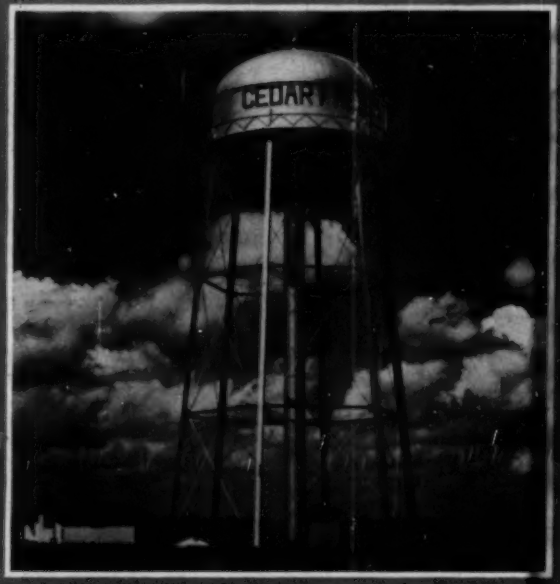
10132 MEECH AVENUE • CLEVELAND 5, OHIO

HERE'S WHERE BETTER WATER SERVICE *Begins*

for Cedar Falls, Iowa

PITTSBURGH • DES MOINES





Elevated Steel Tanks

Dependable water supply, at uniform pressures around the clock, is assured for Cedar Falls, Iowa, by these Pittsburgh-Des Moines Elevated Steel Tanks.

Located strategically for balanced distribution in the water system, both tanks are of Double-ellipsoidal design. The unit shown at left has a capacity of 500,000 gallons, and a tower height of 68'4". The second tank holds 250,000 gallons, on a tower 87'7" high.

• • •

Do you have a copy of our comprehensive Elevated Tank Catalog? It is free on request—a most useful publication.

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25)	3418 Neville Island	DES MOINES (8)	919 Tuttle St.
NEW YORK (7)	Room 918, 270 Broadway	DALLAS (1)	1223 Praetorian Bldg.
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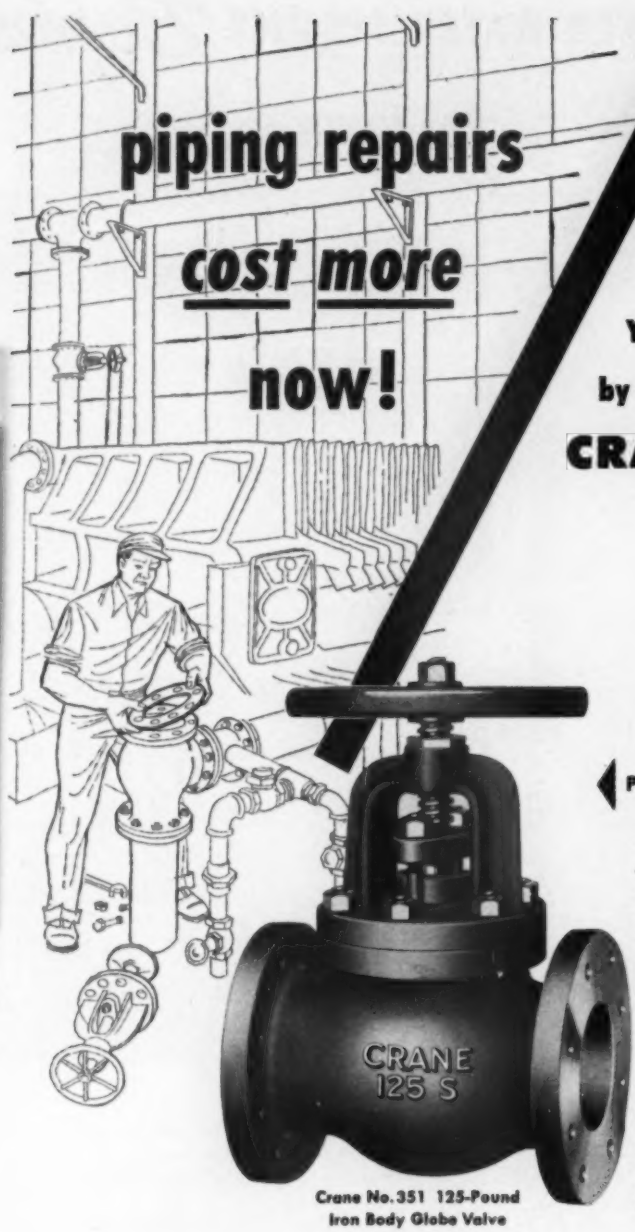
	SANTA CLARA, CAL.	625 Alviso Road	



Crane No. 351 125-Pound Iron Body Globe Valve

piping repairs *cost more* now!

You make fewer of them by using Dependable Quality

CRANE VALVES

...That's why more Crane Valves are used than any other make

Preferred for true, tight seating

For smooth, positive regulation of flow, check Crane quality engineered Iron Body Globes with composition or metal disc. They're easy to operate; easy to maintain. Guide stem under disc assures square seating... true disc travel with minimum vibration. Seat rings are screwed in and can be renewed if necessary.

These rugged valves require little maintenance. Roomy stuffing box with bolted two-piece gland keeps tight stem seal, lengthens packing life. Stem threads are outside valve body, easy to lubricate.

Ask your Crane Representative to show you how Crane Quality valves and fittings not only give you more dependable piping performance... but cost less in the long run.

CRANE CO.

General Offices:
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Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Red Water?
Black Water?
Lime Scale?
Corrosion?

Calgon's Threshold Treatment has become a world-wide standard method of solving problems such as *precipitation of dissolved iron, stabilization of water following softening, scale formation* and *corrosion.*

If you have a problem related to water, let us send you detailed information on exactly what Calgon can accomplish in your situation.

CALGON, INC.
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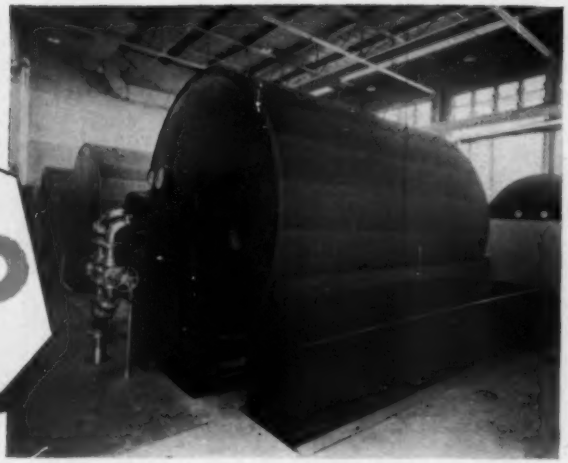
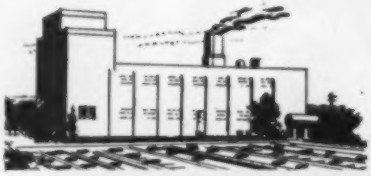
PITTSBURGH 30, PA.



OLIVER FILTERS

in the Minneapolis-St. Paul Sewage Treatment Plant



6 11'6"x14' units installed in 1938

2 11'6"x14' units installed in 1950

In October, you're going to have the privilege of visiting one of the neatest, cleanest, smoothest operating, smartly maintained, sewage treatment plants in the country . . . the Minneapolis-St. Paul Joint Sewage Treatment Plant. It's a plant that is considered by many to be the "example for others to follow."

When going the rounds note the Oliver Filters. If the opportunity presents itself, ask about them: their dewatering ability, capacity, sturdiness, low maintenance, sound engineering. These Olivers uphold their share of operations—the sludge dewatering share—in making this plant a "stand out" in the field of sewage treatment.

When you realize how much more you get by dealing with Oliver United in connection with sludge dewatering problems, you will appreciate why Minneapolis-St. Paul and scores of other cities and towns, have selected Olivers. You will get the full advantage of more than 25 years sludge dewatering experience with all kinds of sludges. You will get filters that are exceptionally well-engineered and carefully constructed. You will get filters with competent filtration engineers to stand back of them always. You will get the filter that has always been in the forefront in the field of automatic, mechanical sludge dewatering.

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Oakland 1 — 2900 Glascock St. San Francisco 11 — 260 Calif. St.
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OLIVER UNITED FILTERS OUF INC.

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CANADA
E. Long, Ltd.
Orillia, Ontario

MEXICO & CENT. AMERICA
Oliver United Filters Inc.
Oakland, Calif.

INDIA
Dorr-Oliver (India) Ltd., Bombay

EUROPE & NORTH AFRICA
Dorr-Oliver S. A. Brussels
Dorr-Oliver S.N.a.R.L. Paris
Dorr g.m.b.h. Wiesbaden (16)
Dorr-Oliver Co., Ltd., London, S.W 1
Dorr-Oliver S.a.R.L. Milano
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AUSTRALIA
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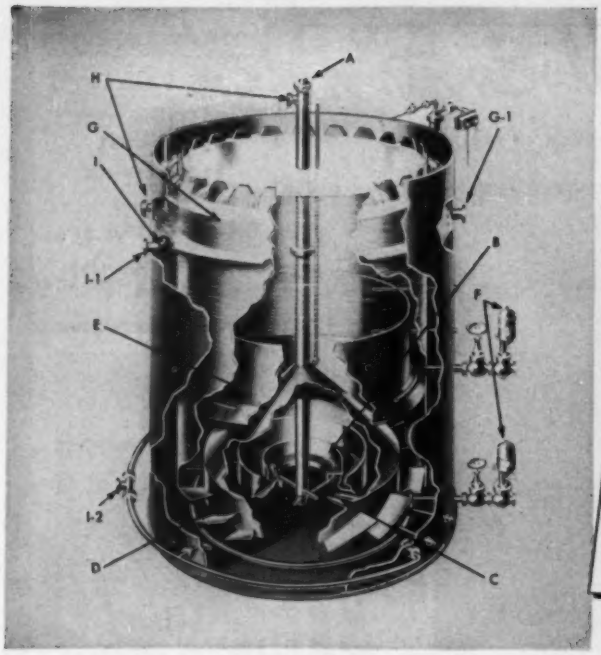
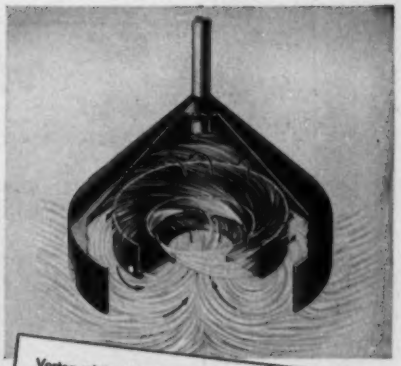




Vortex mixing eliminates need for submerged moving parts in the Worthington Cold Process Slurry Type Precipitation Water Softener and Coagulator.

REACTION TANK of Worthington Slurry Type Softener (Slurry bed eliminated for clarity). (A) Raw water influent line. (B) Vortexor for optimum slurry production. (C) Chemical Applicators. (D) Slurry bed rotator. (E) Symmetrical Slurry concentrator. (F) Proportionate sludge removal. (G) Collector trough for treated water. (G-1) Treated water effluent. (H) Complementary recirculation. (I) Filter wash water compartment. (I-1) Filter wash water suction. (I-2) Filter wash water return.

This slurry bed stays put!

. . . and troublesome variables are out

These Features Give You The Uniformity You Want

WORTHINGTON SLURRY TYPE PRECIPITATING WATER SOFTENER AND COAGULATOR gives consistent, uniformly softened water

If it's clear, uniformly softened water you want, this unique Worthington Water Softener is just what you need. Concentrated quick mixing and rapid recirculation of applied chemicals and raw water, *achieved by hydraulic energy instead of submerged mechanical moving parts*, is an important, progressive development in the water treatment field.

New Bulletin W-212-B5 gives you 16 pages of vital facts about this unique cold process water softening method. Write for your free copy today.

REMEMBER . . .

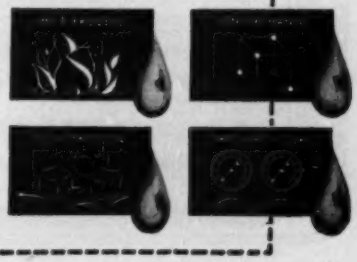
Worthington engineers *all four* water conditioning processes; therefore, can give you unbiased recommendations on which process is right for you . . . further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Harrison, N. J.*

J0.1

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

RUGGED Simplicity

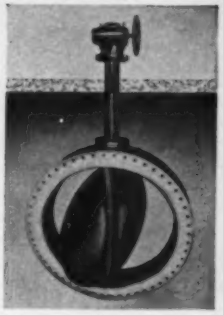
Correctly engineered mechanically and metallurgically, all body assemblies of R-S Valves equal or exceed A. S. A. standards in every detail. These valves are designed and constructed for rugged service and provided with such safety factors that they will exceed service expectations as well as reduce pumping and blower costs.

Consider also the few working parts, greater control rangeability, the self-cleaning feature and the fact that R-S Valves are readily adapted to automatic operation. Know the rugged simplicity of R-S Valves, and get the most from your valve investment.

District offices are listed in telephone directories as, "R-S Products Corp'n Valves".

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

R-S VALVES
Simplify the Control and Shut-off of Volume and Pressure from 2 to 2500 psig
Write for Catalogs 17 and 18



No. 739-740—Sixty-inch, 50-pound Heavy Duty Valve with gear reduction drive and handwheel for handling water at 40 psig. Vertical valve stem enclosed in steel pipe support. Thrust bearing absorbs vertical load.

No. 730—R-S Heavy Duty Floor Stand for rugged service in connection with any standard R-S handwheel operated valve.

No. 767—A 3-Way Valve (Two 24-inch 125-pound Cast Iron Valves bolted to 125-pound American Standard Tee). Electric motor operated by cross linkage. Automatic declutching handwheel for emergency operation.

Chemicals you live by

UNLESS YOU WOULD LIKE CHLORINE IN A BUCKET...

Our biggest problem in supplying you with cylinder chlorine today isn't the lack of chlorine—it's getting the empty cylinders back from your plant. In other words, to keep a continuous flow of chlorine going from our plants to you, we must have your empty cylinders returned to us.

The M-31 order assures you an adequate supply of chlorine so there is no need for any consumer to worry or to overstock. But M-31 does not take care of getting the empties back from you to us. Without empty cylinders we cannot renew your order.

To help us give you prompt delivery—please return empties as fast as possible and please do not keep more cylinders standing around than necessary for reasonable protection of your supply.

DIAMOND JUBILEE · AMERICAN CHEMICAL SOCIETY · WORLD CHEMICAL CONCLAVE · SEPTEMBER 1951

DIAMOND ALKALI CHLORINE

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DIAMOND ALKALI CHEMICALS

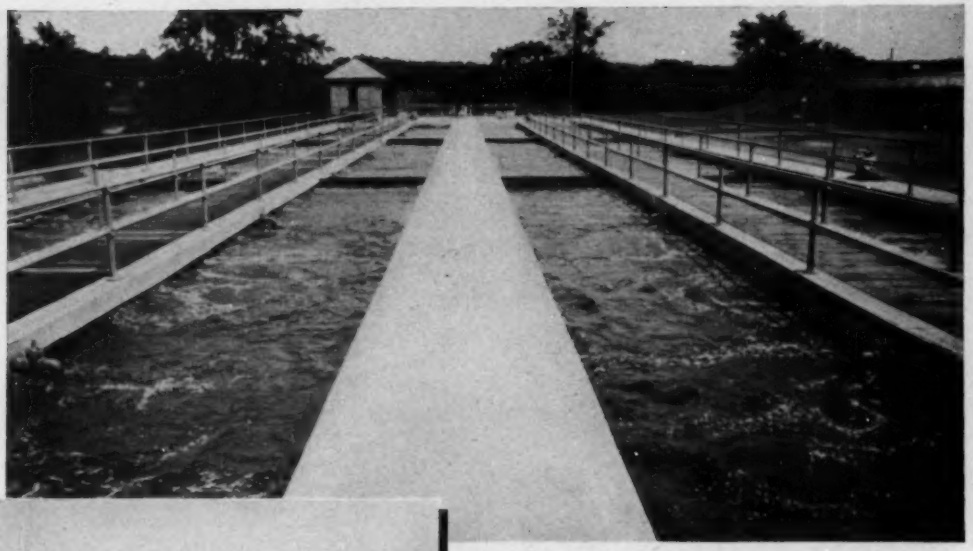
View of four bodies of 54" ROTOVALVES with two plugs in the background. These valves are part of a large order under construction for the City of New York, Board of Water Supply, Delaware Aqueduct Project.

A Very Real Contribution to Water Works Development!

The ROTOVALVE answers the ever increasing need in the waterworks field for a valve which couples ease of operation with positive performance under both normal and emergency conditions. For these reasons it was selected for both shut-off and throttling services on this important project.

S. MORGAN SMITH Co.

YORK, PENNA. U.S.A.



ACTIVATED SLUDGE PLANT in New England successfully uses easy-to-clean, long-lasting Norton Alundum* porous plates.

No other porous medium offers you so many advantages as *Fused Alumina*

Norton Alundum (fused alumina) porous mediums for sewage treatment and water filtration are characterized by effective resistance to chemical attack and to abrasion, as well as by great strength and uniform structure.

Chemically Stable!

They are unaffected by acid, neutral and slightly alkaline conditions encountered in these applications. In fact, 30-day immersion tests of Alundum plates in such solutions as 85% phosphoric acid, 96% sulphuric acid, 35% hydrochloric acid, sat. sol. calcium hydroxide showed insignificant cumulative losses.

Exceedingly Strong!

And look at the strength of Norton Alundum plates. Their modulus of rupture, when they are wet, ranges from 1465 psi for a plate with a permeability of *121.0 cu ft/min/sq ft/in. thick* at 2 in. water pressure to 3716 psi for a plate with a permeability of 4.1. So, you can see a Norton Alundum porous plate has sufficient strength for successful application in either sewage treatment or filtration plants.

Highly Refractory!

Because they are fired at high temperatures, Norton Alundum porous mediums resist properly applied temperatures up to 1000° C without any change in physical structure. This gives you the advantage of being able to burn out organic matter if the pores become clogged without endangering the characteristics of the plates.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

Get All The Facts!

For the complete data on the selection, installation and upkeep of Norton Alundum porous mediums for sewage treatment applications, write for Catalog 1246; for filtration, request Catalog 140. Norton Company, 824 New Bond Street, Worcester 6, Massachusetts.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

POROUS MEDIUMS

Impact Insurance Against

1—LOSS OF FIRE PROTECTION.

2—EXCAVATION AND PAVEMENT REPLACEMENT.

3—COSTLY REPAIRS INVOLVING MAJOR HYDRANT COMPONENTS.

4—FLOODING.

The Smith Protectop Hydrant is designed to permit rapid return to service at minimum cost when a Hydrant is damaged as a result of a traffic accident.

The Protectop Hydrant Standpipe and Valve Stem are equipped with *Special Couplings* located just above the ground. The Couplings withstand operating pressures and ordinary impact with an ample factor of safety. Under excessive impact occasioned by traffic accidents the Couplings fracture at the design points thus minimizing the damage and permitting speedy return to service at low cost.

All Smith Hydrants are equipped with *Compression Type Valves* which definitely eliminate flooding since the line pressure holds the Valve against its seat in the closed position.

Write for details.

35

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

SIMPLICITY of AMERICAN FROST BOTTOM METERS

REDUCES YOUR REPAIR COSTS

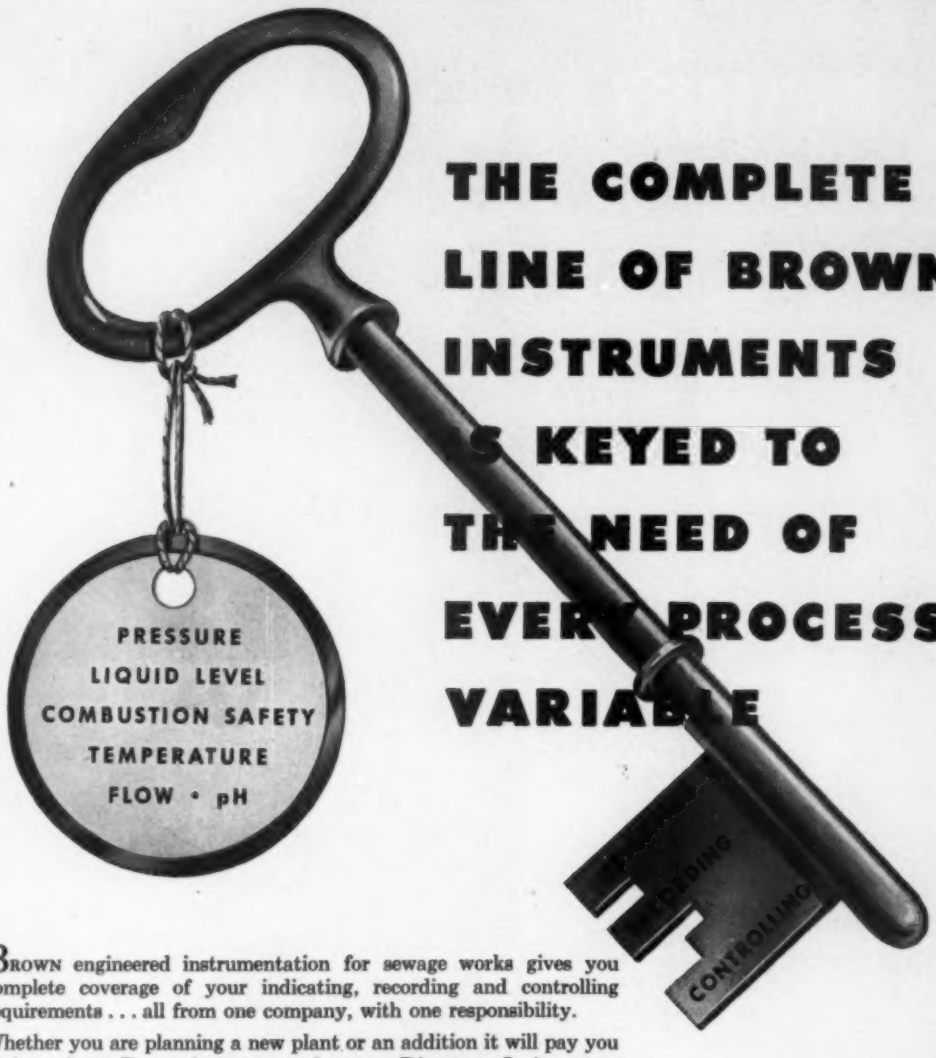
There's no worry about freeze-ups of American Meters causing high repair bills. The simple patented frost bottoms break at the correct pressure to protect all other parts, because they are not affected by the tightening of the flange bolts.

Even replacement frost bottoms give the same protection because the breaking pressure is pre-tested at the factory and predetermined by the machining which produces the correct tensile strength.

Complete data available — write today.

BUFFALO METER CO.

2909 MAIN STREET, BUFFALO 14, NEW YORK



THE COMPLETE LINE OF BROWN INSTRUMENTS IS KEYED TO THE NEED OF EVERY PROCESS VARIABLE

BROWN engineered instrumentation for sewage works gives you complete coverage of your indicating, recording and controlling requirements . . . all from one company, with one responsibility.

Whether you are planning a new plant or an addition it will pay you to investigate Brown instruments for your Digestors, Incinerators, Elutriators, Sludge Lines, Room Heating, Dryers, Boilers and Mixing Basins.

A nation-wide engineering and service organization is at your command. Call in our local representative today . . . he is as near as your phone . . . or write for a copy of comprehensive Catalog 7301.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4575 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

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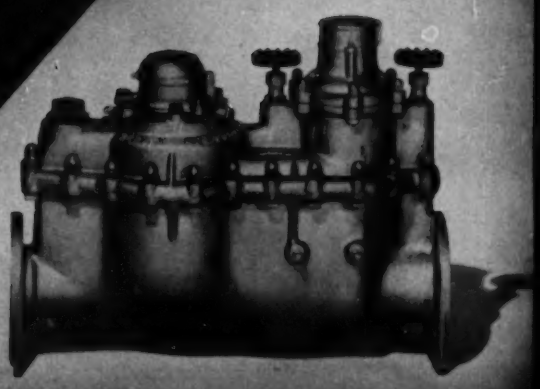
Brown Instruments

HERSEY



When the Lid of a

COMPOUND WATER METER

bears the name HERSEY, experienced water works officials know they are getting a Meter with a reputation for accuracy, long life and low maintenance cost. Remember, only HERSEY makes this exclusively designed Compound Water Meter.

All Bronze Case from 2" to 6"

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
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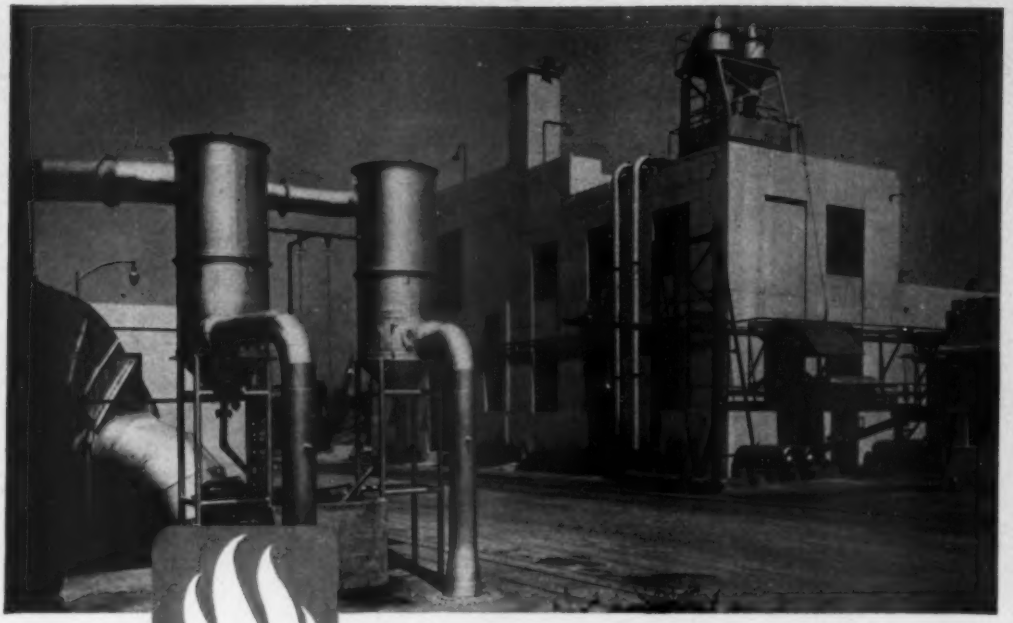


New C-E Flash Drying Unit at San Diego Extension

...almost triples capacity of original installation

When San Diego's Sewage Treatment Plant went into operation in 1943 it was equipped with a C-E Raymond Flash Dryer Unit designed to handle 63 tons of filter cake per day. Shortly after the war plans were made to increase the capacity of the plant to meet the growing needs of the San Diego area.

In June of 1950 the San Diego Extension went into operation, serving an equivalent population of more than 500,000. The C-E Flash Dryer Unit at this extension handles almost double the amount of filter cake as the original unit — 110 tons per day. The evaporation rate of the second unit is about 5000 pounds per hour.

San Diego Extension, as well as the original installation, is typical of C-E Raymond System installations, now in service in virtually all parts of the country, meeting the varying requirements of both large and small communities. They are flexible in layout, highly efficient and thoroughly reliable; they provide for maximum utilization of waste heat.

The services of C-E specialists are available to assist you in finding the best solution to your sludge problem. Get in touch with the office nearest to you for prompt attention. B-525

Representative list of C-E Raymond installations since 1945

BALTIMORE, Md.	SAN FRANCISCO, Calif.
BETHLEHEM, Penna.	SCHENECTADY, N. Y.
BLOOMSBURG, Penna.	SHEBOYGAN, Wis.
CHICAGO, Ill. (W. Southwest)	WASHINGTON, D. C.
FOND DU LAC, Wis.	WATERBURY, Conn.
HOUSTON, Texas	WYOMISSING VALLEY, Penna.
LOS ANGELES, Calif.	COLNE VALLEY, England
SAN DIEGO, Calif. (Extension)	RECIFE, Brazil

COMBUSTION ENGINEERING—SUPERHEATER, INC.

1315 North Branch Street — **FLASH DRYER DIVISION** — Chicago 22, Illinois

Western Office: 560 W. Sixth, Los Angeles 14, Calif. — Eastern Office: 200 Madison Ave., N. Y. 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

HYDRAULIC CATCH BASIN CLEANER ALONE PAYS FOR VERSATILE HYDROCRANE

With big loads like this, it only takes a few passes and the Hydrocrane is off to another catch basin. And note this feature: the Hydrocrane's boom —which telescopes in and out hydraulically — is unmatched for close quarter work under low overhanging tree branches and wires.

IN considerably less than a year, actual figures* show, the Hydrocrane's hydraulic catch basin cleaner can save enough money to completely pay for the whole truck crane! For example, even in a system with as few as 2500 catch basins, the impressive savings over hand labor with this attachment alone can pay for a Hydrocrane in less than a year. And when you add the Hydrocrane's value for setting pipe, uncovering leaks or trucking, it's easy to see why this handy truck crane is tops in its field.

Operation is extremely simple. The hydraulically powered crane eases the orange-peel type bucket down into the catch basin. When it reaches bottom, the operator touches his control lever and a powerful hydraulic ram pulls the bucket lips tightly around the muck and debris. A flick of another lever and the load is hoisted out and dumped. Hand levers only — no tricky hand-foot coordination.

Users report this bucket is particularly valuable where bottles, bricks and other hard materials are dumped into the sewer, because here suction type machines simply won't work. And it's fast! Under normal working conditions the Hydrocrane has cleaned as many as 36 catch basins per day.

Get full details on this new, cost-cutting way to clean catch basins. Two Hydrocrane sizes, ¼-yd., 2-ton, ⅜-yd., 3-ton. Send coupon for details.

*we'll be happy to explain them in detail

BUCYRUS ERIE HYDROCRANE

SOUTH MILWAUKEE, WISCONSIN

BUCYRUS-ERIE HYDROCRANE DIVISION
South Milwaukee, Wisconsin

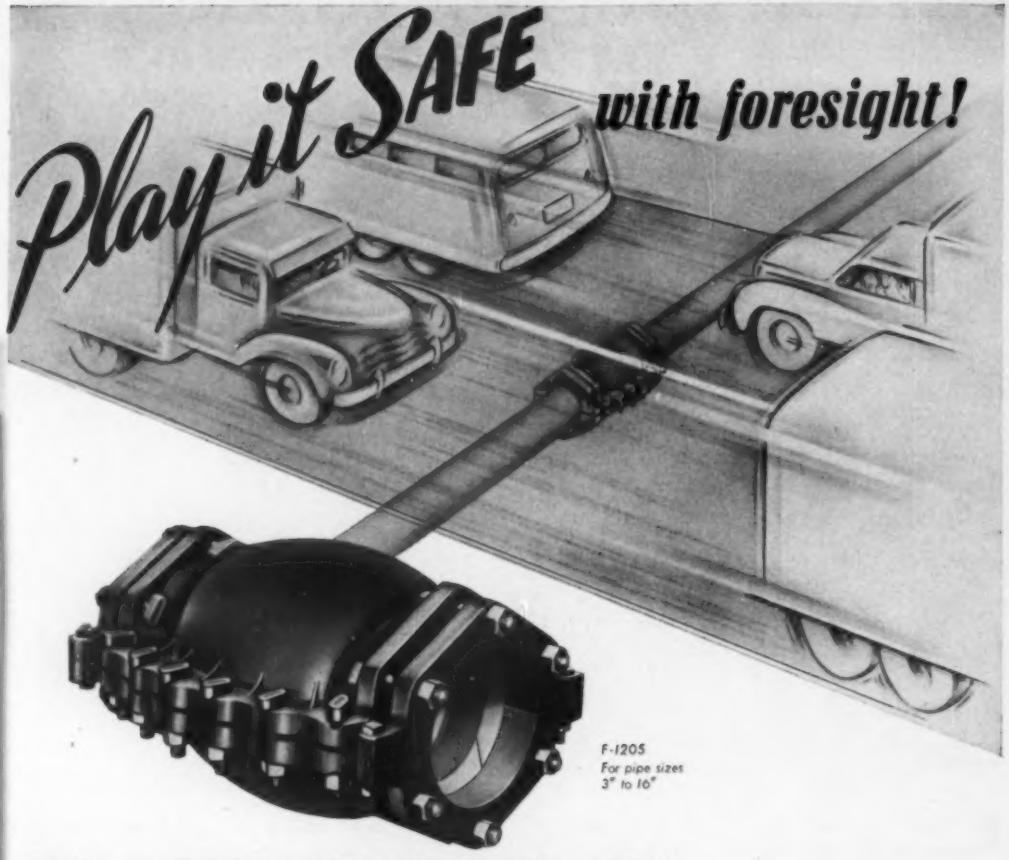
Gentlemen: ☐ Please send Hydrocrane literature.
☐ I want a Hydrocrane demonstration.

Name_____

Company_____

Address_____

City_____ State_____



F-1205
For pipe sizes 3" to 16"

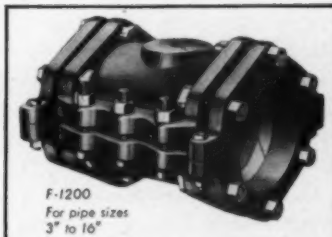
Reinforce all joints subject to vibration with

CLOW

Mechanical Joint BELL SPLIT SLEEVES

When ponderous trucks roar and rumble by, even our finest highways tremble with vibration . . . and so does the water pipe buried below! That's why it's best to play it safe: don't wait for a break; have the foresight to install Clow Mechanical Joint Bell Split Sleeves as *original equipment* wherever the pipe must pass under highway truck routes or under railroad tracks. Specify them for marshland or under water, too—in fact, everywhere that pipe is not readily accessible in case of emergency. They're easy to install . . . no lead, no jute, no caulking!

Write for circular with helpful information and illustrations



F-1200
For pipe sizes 3" to 16"

Use these F-1200 Clow Mechanical Joint Straight Split Sleeves for permanent repairs to pipe barrels. 12" and smaller sizes will repair lengthwise breaks up to 8 inches; 14" and 16" sizes, up to 17 inches.

JAMES B. CLOW & SONS

201-299 North Talman Avenue • Chicago 80, Illinois

and their National Cast Iron Pipe Division, Birmingham, Alabama; subsidiaries Eddy Valve Company, Waterford, N.Y.; Iowa Valve Company, Oskaloosa, Iowa

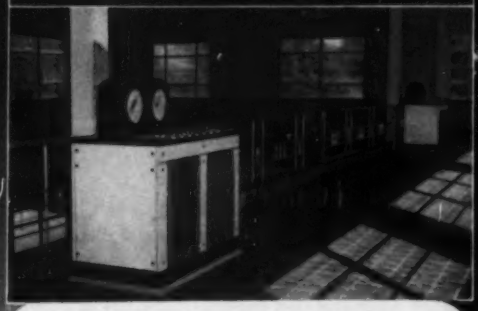
AUGUSTA, GA.

Filtration Plant

(ADDITIONS COMPLETED 1950)

ROBERT AND COMPANY
ASSOCIATES
Architects and Engineers
ATLANTA, GA.

M. B. COOPER
Supt. of Canal and Water Works
AUGUSTA, GA.



B-I-F Industries Equipment furnished for the enlargement to the Augusta Filter Plant:

Builders 16" Model RCE Controllers with Loss of Head and Rate of Flow Filter Gauges.

Omega Loss-in-Weight Gravimetric Feeders for Alum, Lime and Carbon.

Augusta's water system dates back to 1818 when springs were the source of supply and wooden mains the mode of conveyance. Today it takes the Savannah River and this modern Filtration Plant to supply the needs of the city's 120,000 people. Constant municipal growth has been paralleled by periodic enlargements and improvements in the Augusta water system. The latest of these, recently completed, has increased the Augusta Filtration Plant from 15 to 21 MGD. max. rated cap., assuring the city an ample supply of pure water of controlled taste, odor, and pH. This latest construction was carried out by the general contractors, Batson-Cook Co. of West Point, Ga. In addition to new filters, the enlargements to the plant include Builders Controllers and Gauges — engineered to promote efficient filter operation and to assist Supt. H. G. Wylds in the operation of the plant. For Bulletins describing Builders Water Works Equipment, address Builders - Providence, Inc. (Division of Builders Iron Foundry) Providence 1, Rhode Island.

BIF INDUSTRIES

BUILDERS-PROVIDENCE

BUILDERS

Facts

ABOUT FAIRBANKS-MORSE DUAL FUEL ENGINES

- Over 160,000 hp. sold — 128 engines.
- Savings reported over 50% in fuel cost.
- Field conversion parts available for many models.
- Basic Fairbanks-Morse design advantages—2 cycle, low rpm, low BMEP, fewer moving parts, proved record of performance.

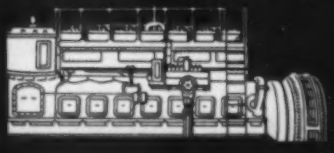
A Sure Way to Get Lower Cost Kw-h!

Wherever sewage or natural gas is available, diesel plant operators are producing lower cost kw-h by converting to dual fuel—or installing new dual fuel engines. Leading the trend in this relatively new diesel development is Fairbanks-Morse, with field conversion parts for many popular sizes of Fairbanks-Morse diesels—and with a growing line of factory-built dual fuel engines. If you haven't thought of the savings dual fuel operation can bring to your plant—you should. Write for information, stating size and type of engine in which you are interested. Fairbanks, Morse & Co., Chicago 5, Illinois.

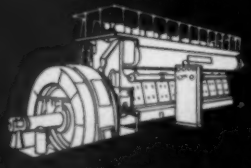
FAIRBANKS-MORSE,

a name worth remembering

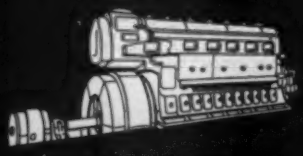
DIESEL AND DUAL FUEL ENGINES • ELECTRICAL MACHINERY • PUMPS • SCALES • DIESEL LOCOMOTIVES • RAIL CARS • MAGNETOS • FARM MACHINERY



Model 31: Up to 3500 hp.



Model 33: Up to 2000 hp.



Model 38: Up to 2000 hp. (Opposed-Piston type)

CONTROLLED DIGESTER TEMPERATURE for Father Knickerbocker!

Latest addition to the P. F. T. sewage treatment equipment serving New York and environs are four P F. T. No. 634 Heat Exchanger units, one of which is shown above, installed at the Hunt's Point Sewage Treatment Plant.

Each unit has an output of 3,625,000 B.t.u. per hour and a combined output of 14,500,000 B.t.u. per hour.

Waste heat from sewage sludge gas engines is utilized. Sludge from the digesters is circulated through 6-inch tubes in the P. F. T. Heat Exchanger which are within 8-inch tubes, forming an annular space through which engine jacket cooling water is circulated to provide efficient heating of the sludge. Raw sludge is preheated in the same unit.

This highly efficient method of preheating raw sludge and maintaining sludge in the digester at optimum temperature is proving a boon to many cities. Similarly, P. F. T. Digester Heaters utilize sludge gas as fuel to heat the water bath enveloping the sludge tubes. Complete data on this equipment is contained in Bulletin 235—which will be sent on request.

P.F.T.

PACIFIC FLUSH TANK CO.

Waste Treatment Equipment Exclusively Since 1893

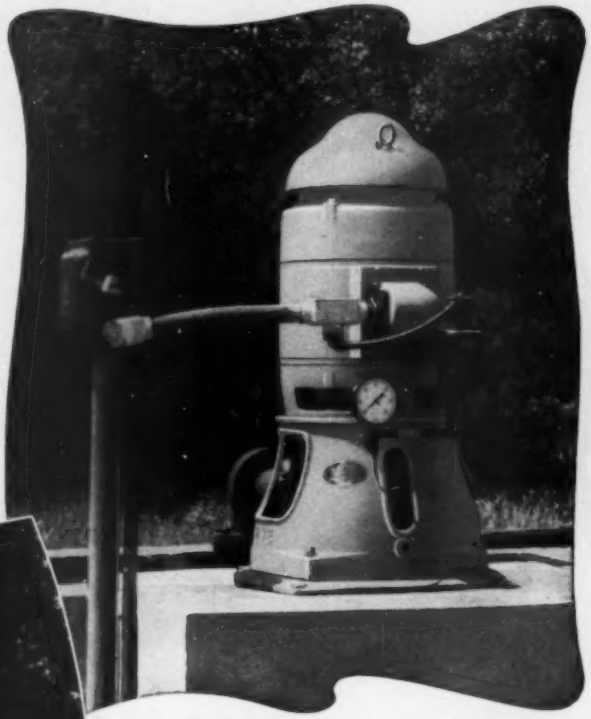
4241 RAVENSWOOD AVE. CHICAGO 13, ILLINOIS

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

INSTALLED FOR THE CITY OF

TOMS RIVER, New Jersey

. . . WITH her population more than doubling during the summer season, the resort city of Toms River, New Jersey, was facing a serious water shortage problem. Five old, inefficient and not too dependable wells were being operated with suction pumps. Layne was called in for a discussion of what could be done with limited funds. Layne's recommendations resulted in a contract for the rebuilding and re-equipping of one old well and the drilling and equipping of a new one. The contract also called for equipping one pump with an auxiliary, gasoline engine drive, on one of the pumps, for use in case of electric power failure. Without delay everything was finished according to the contract, giving the city of Toms River a water supply that more than fulfills present needs. The new equipment also greatly reduced operation cost which more than justified the investment.



Built Complete by Layne

Everything, with the exception of some wiring for the Toms River job was handled complete by Layne in one inclusive contract. Each phase of the work was under the supervision and direction of Layne engineers who made sure that all materials and method of installation were up to Layne's very exacting standards. The entire job handled in one contract was an important factor in saving time, extra expense and unnecessary worry for the Toms River city officials. Furthermore it assured the city of obtaining a completely satisfactory job throughout.

LAYNE & BOWLER, INC.
General Offices, Memphis 8, Tenn.

★★★★★★★★★★★★★★★★★★★★★★★★

Catalog on Layne
WELL WATER SYSTEMS

Fifty-two pages of highly interesting and fully illustrated details on the Layne method of building the world's finest well water systems. Shows pictures of many installations for cities, factories, pipe lines, petroleum refineries, etc. Sent without obligation.

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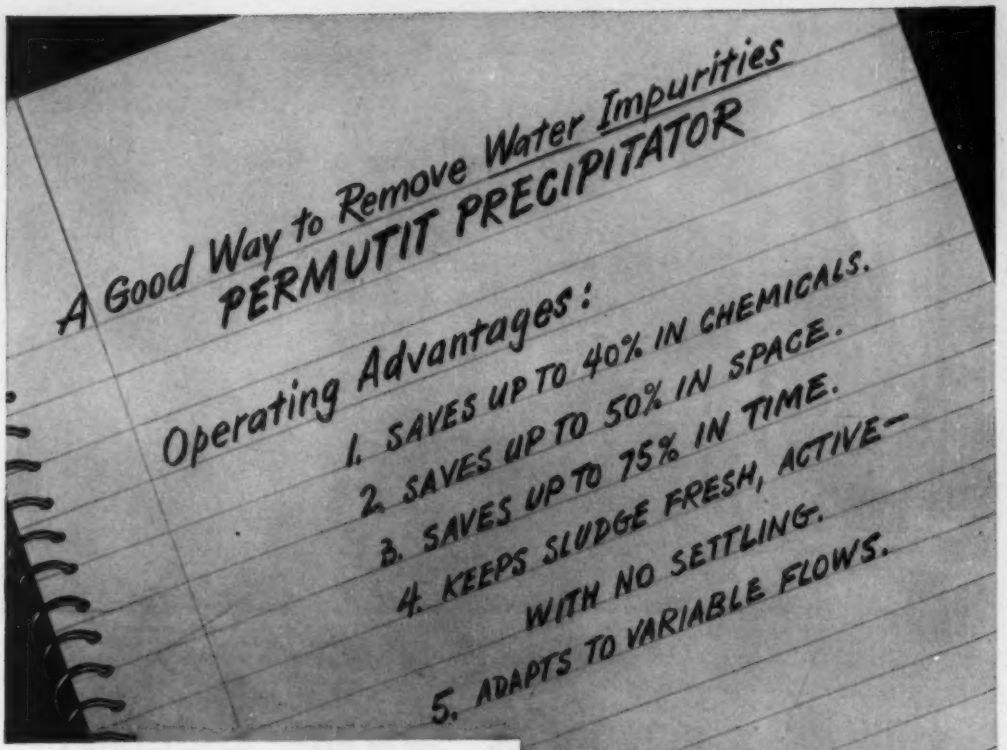
Layne
WATER SUPPLY
WELLS & PUMPS


A Good Way to Remove Water Impurities
PERMUTIT PRECIPITATOR
Operating Advantages:
1. SAVES UP TO 40% IN CHEMICALS.
2. SAVES UP TO 50% IN SPACE.
3. SAVES UP TO 75% IN TIME.
4. KEEPS SLUDGE FRESH, ACTIVE—
WITH NO SETTLING.
5. ADAPTS TO VARIABLE FLOWS.

HOW IT WORKS:

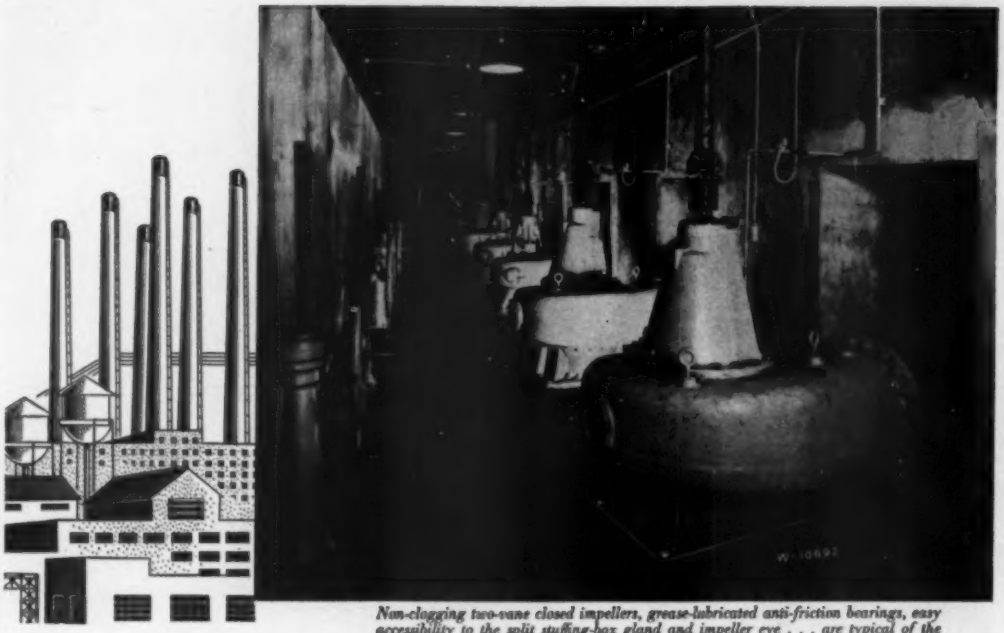
The Precipitator operates on the principles of precipitation, absorption, settling, and upward filtration. It is adaptable for water softening, removal of turbidity, color, taste, odor, alkalinity, silica, and fluorides.

Precipitator capacities range from 1,000 gals. per day to 10,000,000 gals. per day. Batteries handling up to 120,000,000 gals. per day are currently in use in some municipalities.

Write for free bulletin to The Permutit Company, Dept. W-10, 330 West 42nd Street, New York 18, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

PERMUTIT®

WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS



Non-clogging two-vane closed impellers, grease-lubricated anti-friction bearings, easy accessibility to the split stuffing-box gland and impeller eye . . . are typical of the many Worthington MIXFLO *features assuring low-cost, trouble-free sewage pumping.*

How is Bridgeport's Sewage Pumped?

It's full of industrial waste . . . a problem built for Worthington Pumps

Here's another municipality which has turned its sewage pumping over to Worthington—100%.

These five Worthington Vertical MIXFLO sewage pumps are located in Bridgeport's Westside sewage plant—installed in 1946. Three are 20-inch, two are 16-inch MIXFLOS.

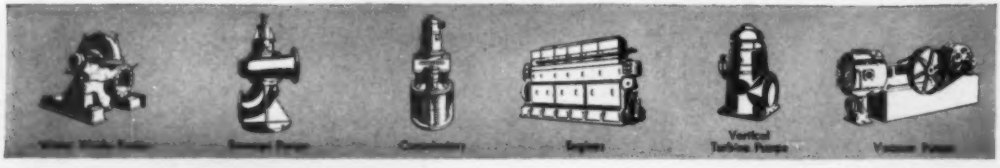
Bridgeport's Eastside plant duplicates these five pumps, and in addition uses two Worthington dry vacuum pumps and a Worthington air compressor.

In many other places, too, Worthington—world's largest manufacturer of pumps—is keeping pace with developments in sewage treatment and disposal by furnishing pumps of utmost dependability.

The Worthington MIXFLO line offers the industry's widest choice of sizes and types. So take a tip from New York, Chicago, Philadelphia, Bridgeport—find out why *there's more worth in Worthington.* Write Worthington Pump and Machinery Corporation, Public Works Division, Harrison, New Jersey.

WORTHINGTON

SEWAGE PUMPS W.1.1



Send for your new

griductor®

bulletin 5100-A

NEW FACTS ON BETTER SOLIDS REDUCTION

Straight channel sewage screening and cutting with the Griductor is proving itself all over the nation. Now here is new data on:

1. Griductor intermittent cutting and shearing.
2. Installation methods.
3. Specifications, dimensions, capacities.

- *** MORE SETTLEABLE SOLIDS**
- *** MORE SLUDGE TO DIGESTER**
- *** INCREASED GAS PRODUCTION**
- *** LESS CLOGGING OF TREATMENT UNITS**

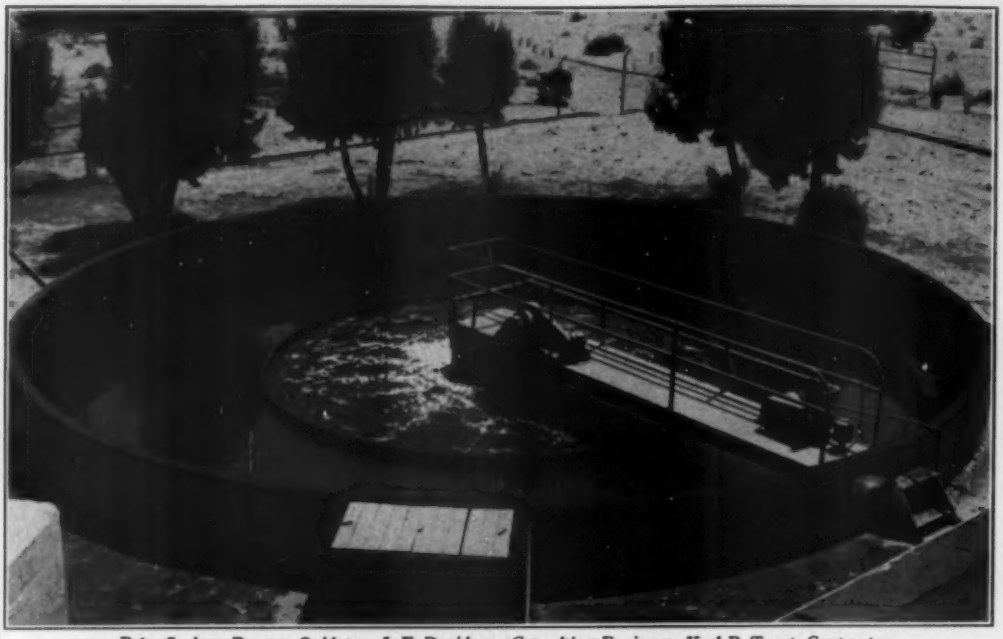
Send Now for Griductor Bulletin 5100-A

INFILCO
• BETTER WATER CONDITIONING • AND WASTE TREATMENT SINCE 1894

INFILCO INCORPORATED | *Tucson, Arizona*

FIELD ENGINEERING OFFICES IN 26 PRINCIPAL CITIES

World's Leading Manufacturers of Water Conditioning and Waste-Treating Equipment



Palm Springs Process Oxidator. J. F. Davidson, Consulting Engineer. Karl P. Teget, Contractor.

Palm Springs Modernizes Sewage Treatment With Process Oxidator

Original One Tank Aeration, Coagulation and Sedimentation Unit with Sludge Recirculation as Pioneered by Process Engineers Again Proves Successful

California's famous desert resort, Palm Springs, used a conventional 40′ Clarifier to serve the needs of a population that varies from less than 5,000 in the summer to more than 25,000 during the winter season. The low flow and high temperature of the sewage in the summer produced an odor which was objectionable to the nearby residents, while the increasingly heavy winter flow proved the clarifier inadequate. To remedy this condition, the Sanitary District of Palm Springs, upon the recommendation of its consulting engineer, chose to convert the clarifier to a Process Oxidator.

Since installation, this combination one tank aeration, coagulation and sedimentation unit with sludge recirculation, pioneered and developed by Process Engineers Incorporated, has eliminated the objectionable odor and greatly improved the clarification. (Note aeration in lower photo.)

This conversion, which has resulted in an intermediate treatment at approximately the cost of primary treatment, is the first step in a contemplated expansion program that will eventually include a biological filter and a secondary Oxidator for complete treatment. Having converted the conventional clarifier into an Oxidator, the BOD loading to the proposed biological filter will be greatly reduced, thereby reducing the size and cost of the biological filter.

The conventional clarifier was first installed during World War II when shortages of materials necessitated the use of wooden walkways, wooden weirs, wooden scum baffles, etc. At the time of conversion to an Oxidator, all wooden parts were replaced with steel.

The Palm Springs installation is another example of the flexibility and efficiency of the Process Oxidator. For information concerning this proven method of sewage treatment, either for improved clarification in existing clarifiers or for new installations, communicate with Process Engineers Incorporated, 6381 Hollywood Blvd., Los Angeles 28, California, or 212 Sutter Street, San Francisco 3, California. Eastern and Middle-Western representative: Pacific Flush Tank Company, 4241 Ravenswood Avenue, Chicago 13, Illinois.

Close view of Oxidator showing Aeration. Patented and patent pending.

THE SPIRAL CONVEYOR

Jeffrey Spiral Conveyor handling alum and lime in a large Water Works Plant. A section of Spiral flight is also shown.

A COMPACT INSTALLATION

Used extensively in Water Works Plants for handling lime, alum or other chemicals—saving time and cost. Jeffrey Spirals make compact installations—can be made dust-tight. No return strand. Capacities vary with size of unit.

Photo above shows a Jeffrey Spiral installation in a large Ohio Water Works Plant. Note the clamped cover used when handling dusty material—also the various rack and pinion valves in the trough bottom for delivery of material when and where needed.

Catalog No. 803-A fully describes and pictures Jeffrey Spirals. Catalog No. 775-A covers our complete line of Sewage, Water and Industrial Waste Treatment equipment.

- Sludge Collectors
- Sludge Elevators
- Grit Washers & Collectors
- Flocculation Equipment
- Bar Screens
- Spiral Conveyors
- Chains — Bearings
- Grinders

THE JEFFREY MANUFACTURING COMPANY

Established 1877

996 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

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Galion (Great Britain Ltd.), Wakefield, England
The Ohio Malleable Iron Co., Columbus, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio

Rochester selects ALOXITE underdrains for new filtration plant

Information Courtesy Rochester Dept. of Public Works

Photo by Fairchild Aerial Surveys, Inc.

Rochester, New York, is supplementing its upland water supply by bringing in water from Lake Ontario. In connection with this project, it joins the growing list of cities that are installing ALOXITE aluminum oxide plates as underdrains for rapid-sand filters.

The Lake Ontario water, being somewhat turbid at certain seasons, has required construction of a new filter plant. Initially this new plant will have sufficient capacity to handle 36 millions of gallons per day. There are 12 rapid-sand filters, each consisting of two beds roughly 31 feet by 18 feet, and each having a capacity of 3 mgd. The bottoms are constructed of ALOXITE plates exclusively—supplied by The Carborundum Company. These underdrains will be covered by 24 inches of specially graded sand, with plans calling for 144 surface washers and a wash-water capacity of 8,500 gallons per minute.

Rochester is to be congratulated on its new plant—and upon the speed with which it was constructed. Our contribution—the porous plate underdrains—will go a long way toward keeping the city happy with low operating and maintenance costs.

Rochester's new supplementary water system is being installed under the direction of Mr. Edward F. Nier, Commissioner of Public Works, and Mr. Kenneth J. Knapp, City Engineer.

May we send you our new booklet, "Porous Media for Filtration and Diffusion"? Its 56 pages are crammed with useful data. No obligation, of course.

Porous plates and diffusers by

CARBORUNDUM

Trade Mark

Dept. M-101, Refractories Division

The Carborundum Company, Perth Amboy, N. J.

"Carborundum" and "Aloxite" are registered trademarks which indicate manufacture by The Carborundum Company

paper sculpture by gerardo adan

EFFICIENCY IS INHERENT

in **NIALK*** *Liquid Chlorine...*

processed for highest purity and uniformity...

by the pioneer producer of liquid chlorine for

water and sewage sanitation.

*Trade-mark

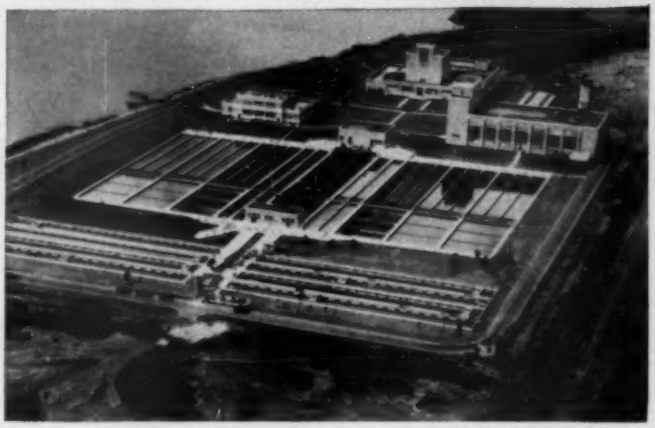
NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, N. Y.

Liquid Chlorine • Caustic Potash • Carbonate of Potash • Paradichlorobenzene • Caustic Soda • TRICHLORethylene
NIAGATHAL* (Tetrachloro Phthalic Anhydride)

Take a bow, boys

of the Minneapolis-St. Paul Sanitary District



When sewage treatment equipment is kept in perfect operating condition for over 14 years, we think the men responsible deserve a hearty round of applause. That's why we say, "Take a Bow, Boys" to the supervisory, maintenance and operating men at the Minneapolis-St. Paul Sewage Treatment Plant. We don't want to put our elbow out of joint, but we think you'll agree that a record like this proves the equipment they have to work with must be "tops," too.

It was over 14 years ago that 22 Rex® Longitudinal Sludge Collectors, 6 Rex Cross Sludge Collectors and 22 Rex Automatic Skimmers were installed in this plant. Today, thanks to wise selection, proper maintenance, efficient operation and the inherent quality in design and construction of Rex equipment, all units are still going strong, looking and operating "just like new." We think the St. Paul-Minneapolis operation is an excellent example of the cost-cutting results that can be obtained when good men are provided with the best equipment. Chain Belt Company, 1610 West Bruce St., Milwaukee 4, Wis.

DON'T FORGET to visit the Rex display in booths 21 and 22 at the Municipal Auditorium during the Federation of Sewage and Industrial Wastes Association Convention in St. Paul. Our engineers will be there to discuss with you your sewage and industrial wastes problems.

CHAIN BELT REX COMPANY ®

BADGER PRECISION MEANS "MORE FOR YOUR METER-MONEY"

"MEASURING THE WATER OF THE WORLD"

First for Accuracy • Low-Cost Maintenance • Durability • Sensitivity

BADGER *Water* METERS

BADGER METER MFG. CO., Milwaukee 10, Wis.

Branch Offices: New York City • Philadelphia
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HERE'S *proof*

THAT TRIDENTS DON'T BECOME OBSOLETE

1898 Trident Meter

UP-TO-DATE TRIDENT PARTS

IN an old style water meter . . . no matter how often you replace worn out old parts with new old-style parts you've still got the same old meter.

BUT when you put UP-TO-DATE parts into an "old" Trident Meter (whose originally sound basic design has not changed in 50 years) . . .

BROTHER, you've got a water meter better than when it was new . . . a meter that holds its place alongside modern meters in accuracy and value.

THIS picture proves you CAN put new parts into "old" Tridents. Proof of how well they work is found in the records of many water departments.

231

The Symbol of SUSTAINED ACCURACY

NEPTUNE METER COMPANY • 50 West 50th Street • NEW YORK 20, N. Y.
Branch Offices in Atlanta, Boston, Chicago, Dallas, Denver, Los Angeles, Louisville, North Kansas City, Portland, Ore., San Francisco.
NEPTUNE METERS, LTD., Long Branch, Ont., Canada

WATER & SEWAGE WORKS

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FERTILIZER PLANT at Battle Creek, Mich. Sewage Treatment Works

Battle Creek Sewage Plant Produces New Product

by ROBERT R. McINTOSH, *Director, Dept. of Public Works, Battle Creek, Mich.*

SINCE 1936, the City of Battle Creek, Mich., a community of diversified industry giving employment to 50,000 inhabitants, has been served by a primary sedimentation and separate sludge digestion type sewage treatment plant. This plant also serves the military establishment at Fort Custer including one military hospital and one veterans facility hospital. The population at the military establishment and the two hospitals has varied from a peace time average of 5,000 to 6,000 to a war footing population of 15,000 to 30,000.

The city is located on the main lines of the New York Central and Grand Trunk Western Railroads and at the intersection of the Battle Creek and Kalamazoo rivers.

The sewage treatment plant lies on the south side of the Kalamazoo river about 4½ miles west of the City and is located on a tract of land embracing 105 acres adjacent to the north boundary of the 9,000 acre United States Army base at Fort Custer.

From Sludge Beds to Flash Drying

Originally the plant was designed for disposal of sludge by twelve filter beds, each 25 feet wide by 100 feet long, giving a total filter area of 30,000 square feet, entirely underdrained. These beds were used for sludge drying until 1944, at which time a modern fertilizer plant of concrete construction equipped with vacuum filters and a Raymond Flash Drier together with storage bins and sacking equipment was constructed.

From 1944 until 1950 the fertilizer building and equipment were utilized to produce a dried fertilizer which was sold under the name of Battle Creek Plant Food. Local and outside demands for this produce permitted operation from 1944 until 1950 at a small profit. However, increased freight rates and labor costs, together with the construction of more sewage plants throughout the country, limited the sale of the product almost entirely to local consumption, and the plant began to show a loss on fertilizer production.

Something New for a Sewage Plant

Plans were already underway to install additional equipment to reinforce the plant food when experiments developed by Charles Knappen, Sr., President of the Knappen Milling Co. of Augusta, Mich. and H. A. Fick, Superintendent of the Upjohn Richland farm of the Upjohn Co. at Kalamazoo, indicated the possibilities of developing a new product. This product has since been manufactured successfully, from a grey mud-like by-product of penicillin with a smell rivaling Roquefort cheese. These two gentlemen formed a company (now known as the K-F Company) to manufacture the product commercially, from a waste considered useless by the Upjohn Co.

About 2 years ago this raw by-product material was accumulating at

Photo by Kalamazoo Gazette

ODOROUS raw material being delivered at plant.

the rate of 15 to 20 tons daily at the antibiotics plant of the Upjohn Co. Due to its odor, the material, containing about ⅓ gram of penicillin to the pound, was being buried, and finding a graveyard for twenty tons each day was no easy task. Mr. Knappen and Mr. Fick heard about the problem and knowing that other feed companies were attempting to refine the antibiotic material in similar substances, offered to take the material off the Upjohn Company's hands.

Negotiating with the Department of Public Works of the City of Battle Creek the two men leased a large portion of the fertilizer building and equipment at the sewage treatment plant. The plant was sterilized to pass the inspection of the Health Department and a conveyor belt and dumping pit were added to the equipment. Soon a new product, D-P-M was tumbling into fifty pound sacks at the rate of 30 tons of dried material per month.

One of the problems that immediately presented itself was the elimination of a pungent odor in the discharge gases which was annoying to nearby residents. Pilot tests indicate that this will be accomplished by heating the gases from 250° to 450° in a separate chamber in the rear of the Raymond Flash Drier and passing them through a catalyzer. Installation of the equipment is under way and will be completed shortly.

The raw product contains about 80 to 85 percent of moisture and is dried by the utilization of the same drying equipment formerly used to dry Battle Creek Plant Food, i.e. dried sewage sludge. Known as penicillin mycilium, it emerges from the process looking like finely-ground coffee and is distributed to elevator and feed companies who mix it with regular hog and chicken feeds, and more recently with food for horses. Experiments over the past six months in the research department of Cornell University by scientists working in cooperation with the United States Fish and Wild Life Division of the Department of Commerce have developed the fact that the inclusion of a small percentage of this product with the regular fish food has hastened the growth of fish fed in this manner eighty percent over those receiving ordinary fish food.

D-P-M, The Wonder Food

Enthusiasm of farmers who have tried the substance is creating such a demand that the original production of thirty tons per month was raised to 100 tons per month on Oct. 1, 1951. A Bloomingdale, Mich., man reports raising 3½ pound fryers in ten weeks with the help of this product. Tests run on hogs at the Upjohn Richland farm proved that the antibiotic substances could substantially increase weight gains when added to the feed.

D-P-M is also made adaptable for horse and dog diets. A special product for each of these animals, built around the nutritional elements in D-P-M, is sold under the trade names of Canicil,

"D-P-M", the finished product.

SEWAGE TREATMENT PLANT at Battle Creek, Mich.

the dog supplement, and Drimycil, the product for horses.

Just why D-P-M and other antibiotic feed supplements create the results that they do is still theory. Scientists believe, however, that the materials counteract harmful bacteria in the digestive system that are competing with the animal for nutrients, making it possible for the animal to assimulate its food better.

Whatever the reason the result has been described by animal husbandry specialists as the greatest discovery in their field in a generation.

The story of D-P-M is just as remarkable!

A once useless material with an odor that made Roquefort cheese smell like roses has been utilized into a profitable operation that makes plumper pork chops and drumsticks out of hogs and chickens far in advance of their scheduled arrival at the market.

Even more remarkable is the fact that a product has been found that can be produced in the fertilizer division of the Sewage Treatment Plant and it is believed without contradiction that this is the first sewage treatment plant to produce such a product.

And what is most interesting, from the standpoint of the City of Battle Creek, is the fact that more than eighteen million cubic feet of gas which was formerly wasted each year has now been put to a use which will bring greatly increased financial returns over those formerly received from the sale of fertilizer.

And Back To Sludge Beds

Meanwhile the matter of disposing of the sludge cake from the drying beds at the sewage treatment plant has not been neglected. The costs of handling the sludge cake from the drying beds and stockpiling are paid by the K-F Co. Local demand is already absorbing some of this sludge cake and plans are underway to reinforce its fertilizer value in its present state, without removing the 47 per cent of moisture remaining in the material. It is anticipated that eventually the local demand for the reinforced product will absorb all the sludge cake produced.

South Dakota Boasts New Mobile Laboratory

The interior of the new mobile field laboratory of the South Dakota State Health Dept., pictured herewith, is making possible more extensive programs of stream pollution control activities. The compactly designed laboratory is housed in a 22½ ft. conventional Schult trailer unit supplied the Department without interior equipment except for the oil heating unit. It was wired and piped for water to specification of the Engineering Div. of the Department which designed and installed all laboratory benches, cabinets and equipment under the direction of R. J. Stopf, Chief of the Sewage Section, W. W. Towne and Chas. E. Carl, as former and present directors of the Sanitary Eng. Division.

The stripped trailer-coach cost $1800; the cabinets and miscellaneous equipment $1200; combination refrigerator and B.O.D. incubator $850; glassware, laboratory equipment and supplies $1200. The total cost was $5050 completely equipped and stocked.

NEW PUMPING STATION of Corpus Christi, Texas

Storm Water Pumping Stations Solve Corpus Christi Problems

Located on the Gulf of Mexico, and subject to hurricane caused tides and torrential rains, this Texas city has licked its storm-water problem.

THE initial protective measure taken by Corpus Christi against storm flooding of the city was the construction of a 14-foot seawall, extending two miles from the high bluff, where it circles toward the sea south of town.

This wall served to keep the bay waters out, even if they reached the 11-ft. levels of the typhoon of 1919, but the seawall left the main business district and the shore front in a big, low pocket without natural drainage. This area ranged in elevation from 3.5 to 8 ft. above sea level. First essential was a network of storm sewers to carry off rain water. Second requirement was a series of outlets through the seawall to permit run-off at normal tides with gates to keep the sea out at abnormally high tides. Finally, provision had to be made for discharge of rain waters at high tide.

With Myers & Noyes as consulting engineers, Mayor Leslie Wasserman, the Director of Public Works, H. H. Stirman, and General Superintendent of Public Utilities J. W., Cunningham, developed a drainage system designed to meet all the problems. A network of storm sewers was constructed, covering every block in the low area and draining to a 9-foot U-shaped sewer parallel to the waterfront. A series of outflow lines with automatic gates were provided to permit drainage by gravity whenever the tide was below 4 feet.

FARRELL-BIRMINGHAM GEARS drive three F-M 54" pumps

High Capacity Pumping Stations Next Step

The final step was the construction of two pumping stations to handle all drainage when tides blocked the normal outflow and to dispose of rain water when rainfall became too heavy for the normal gravity flow to clear. Station "A" has three 54-in., vertical Fairbanks-Morse pumps, each rated at 75,000 gpm. at a 9-ft. head. Each pump is driven by a 325-hp. Fairbanks-Morse diesel through Farrell-

Birmingham gears which reduce engine speed of 514 rpm. to a pump speed of 301.6 rpm.

Normally, water flows by gravity from the 9-ft. sewer through an 8-ft. concrete outflow sewer which extends 100 yards beyond the seawall into the bay. When tide rises and threatens to back up in this line, or when rain is so heavy that pumps are needed to prevent flooding of the streets, a gate is swung across the outflow sewer and uncovers an opening into the pump suction chamber. The pumps discharge into the outflow sewer beyond the gate, providing positive drainage even at record tide levels.

Station "B" is located at an elevation of 3½ ft., the lowest spot in town. At this station there are two pumping units, a 54-in., 75,000 gpm. Fairbanks-Morse pump driven by a 325-hp. F-M diesel, and a 36-in., 27,000 gpm. Fairbanks-Morse pump driven directly by a 75-hp. F-M electric motor. The electric pumps are automatically operated and controlled by the level of water in suction chamber. Thus the station stands guard against rain water damage in the lowest section of the city. The pump discharges into an elevated outfall from which the water flows to the bay by gravity.

It was deemed important to make the plants self-sufficient and capable of functioning in emergency without any outside source of power. Heavy-duty diesels were chosen to insure dependable performance. These prime-movers can be started and put to work in one minute. It takes four minutes to swing the main sewer gate closed. So important is this station that an operator is kept on duty around the clock.

Since the two plants went into service Corpus Christi has had several heavy rains which would have damaged the city were it not for the drainage pumps. On one such occasion, 2 inches of rain fell within 30 minutes.

FAIRBANKS-MORSE DIESELS—the prime movers

Even in the case of light rains, the diesel-pumps provide a valuable safety factor. If the sewers are filling up, the operator runs two diesels for 30 minutes, which usually is enough to empty the sewers and provide 5,000,000 gallons of underground storage capacity. On top of this, the two plants have a combined pumping capacity of 327,000 gpm.

Accessories and Auxiliaries

Diesel fuel is stored in a 550-gal. underground steel tank for each engine and is picked up by the engines' own supply pumps and sent through duplex bag-type filters to the fuel injection pumps. Lube for each diesel is circulated under pressure to all bearings and cylinders by an engine-driven pump. Oil goes also to cool the pistons and passes through a shell-and-tube oil cooler. Soft cooling water is put through the engine jackets by an engine driven centrifugal pump and is cooled in a heat exchanger. Another gear-driven pump takes raw water from the sump, puts it through the exchanger and back to the sump. Thus, all essential auxiliaries are driven by the diesels themselves. For engine starting, each plant has a motor-driven air compressor and storage bottles. Here again the safety factor has been provided in the form of a compressor driven by a small gasoline engine. There is also a 4-kw. gasoline engine-generator unit at each station.

For safety and ease in operation, there is a gauge board near each diesel with pressure and temperature gauges, alarms on lube pressure and temperature and water temperature, and a multi-point exhaust pyrometer. Scavenging air enters through three-unit impingement-type filters and exhaust gases vent through vertical snubbers.

Corpus Christi has made a considerable investment in protection against flooding realizing that just one combination of high tide and heavy rain would do more damage to an unprotected town than several times the cost of the emergency pumping stations.

Philadelphia Water Dep't. to Operate and Maintain Sewer System and Treatment Plants

Under the new Philadelphia "Home Rule Charter," the old Bureau of Water in the Dep't. of Public Works is to be abolished and an entirely separate Water Department is to be established. The new Charter calls for the improvement, operation, maintenance and repair of Philadelphia's sewerage system and sewage treatment plants by the Water Department.

Rates for supplying water service and sewer service charges are to be set by the Water Department, but charges for such services are to be billed for and collected by a separate Department of Collections. However, the monies collected are to be kept in a separate water and sewerage account which is not subject to transfer to other city accounts.

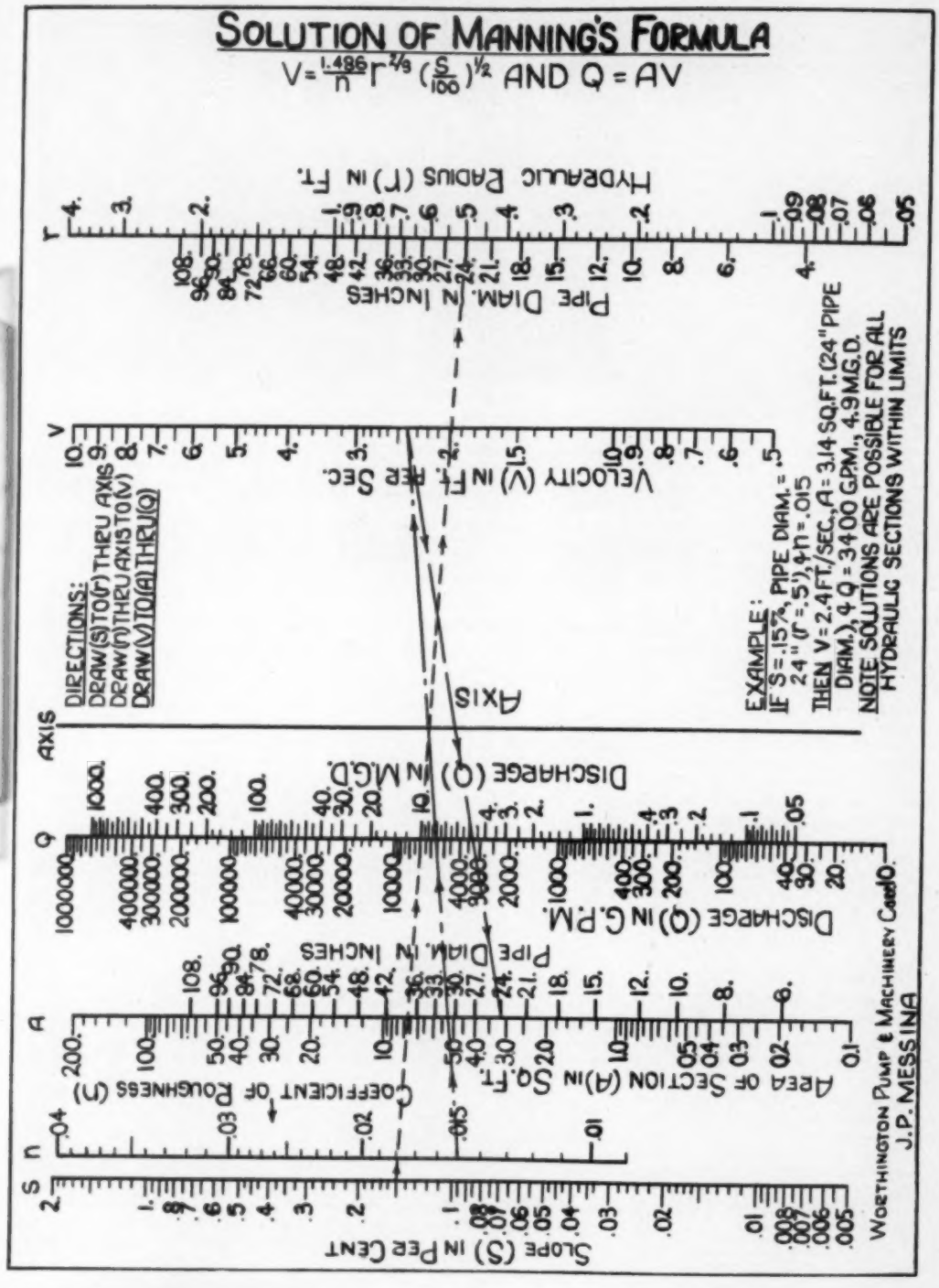
Chlorination of Sewage and Industrial Wastes

"Chlorination of Sewage and Industrial Wastes" is the title of Manual of Practice No. 4 of the Federation of Sewage and Industrial Wastes Ass'ns, just published and released for sale by the Federation.

This authoritative manual of 90 pages covers the history, development and modern technique of chlorine application in all aspects of treatment of sewage, sewage effluents and other water-borne wastes. It constitutes a handbook on chlorination practices and contains a classified bibliography of more than 350 references to the literature on chlorination.

This manual, prepared by a committee of experts, is offered for sale by the Federation at $1.00 per copy to members or $1.25 to non-members. To order a copy, address Federation of Sewage and Industrial Wastes Ass'ns, 325 Illinois Bldg., Champaign, Ill.

Fig. 1—Nomograph for Solution of Manning's Formula


SOLUTION OF MANNING'S FORMULA
$V=\frac{1.486}{n}r^{2/3}(\frac{S}{100})^{1/2}$ AND Q = AV
Hydraulic Radius (r) in Ft.
Pipe Diam. in Inches
Velocity (V) in Ft. per Sec.
Axis
Discharge (Q) in M.G.D.
Discharge (Q) in G.P.M.
Pipe Diam. in Inches
Area of Section (A) in Sq. Ft.
Coefficient of Roughness (n)
Slope (S) in Per Cent
DIRECTIONS:
DRAW (S) TO (r) THRU AXIS
DRAW (r) THRU AXIS TO (V)
DRAW (V) TO (A) THRU (Q)
EXAMPLE:
IF S = .15%, PIPE DIAM. = 24" (r = .5'), & n = .015
THEN V = 2.4 FT./SEC., A = 3.14 SQ.FT. (24" PIPE DIAM.), & Q = 3400 G.P.M., 4.9 M.G.D.
NOTE SOLUTIONS ARE POSSIBLE FOR ALL HYDRAULIC SECTIONS WITHIN LIMITS
WORTHINGTON PUMP & MACHINERY Corp.
J.P. MESSINA

Solution of Manning's Formula

And Velocity and Discharge for Partially Full Circular Sewers

by J. P. MESSINA, *Engineer, Worthington Pump & Mach. Corp. Harrison, N. J.*

THE hydraulic nomograph herewith, designated as "Solution of Manning's Formula (Fig. 1.) has been prepared to solve the equation or the equations:

$$V = \frac{1.486}{n}(r)^{2/3}\left[\frac{s}{100}\right]^{1/2} \quad (1)$$

and

$$Q = AV \quad (2)$$

Solution of Equation (1) is possible for all coefficients of roughness (n), for all shapes and sizes of hydraulic sections (r = hydraulic radius in feet), and for all slopes (s = slope in %), provided the variables are within the limits of the nomograph.

The average velocity (V) is expressed in feet per second and the cross section area (A) in square feet. If the area is known, Equation (2) may be quickly solved by the nomograph. The determination of the discharge or rate of flow (Q) is expressed in convenient units of gallons per minute (gpm.) or million gallons per day (mgd.).

As a further convenience, the hydraulic radii and cross-sectional areas of various size sewers are indicated along each of their respective scales. The directions for the use of the nomograph are shown in Fig. 1. It should be noted that the solution of either equation may be solved in any order, provided a sufficient number of variables are known.

Partially Full Sewers

The curves in Fig. 2 have been prepared and based on Manning's Formula, to determine the "Velocity and Discharge of Partially Full Circular Sewers". This figure shows a comparison of the filled section to a full section of a circular sewer.

In problems dealing with partial flow, the use of this curve eliminates the necessity of calculating the partial hydraulic radius and cross-sectional area. If the sewer section is non-circular, then the nomograph in Fig. 1 must be used for the solution.

For circular sections, however, it is suggested that the full section be solved on the nomograph (Fig. 1) and the actually filled section be compared on the curve in Fig. 2.

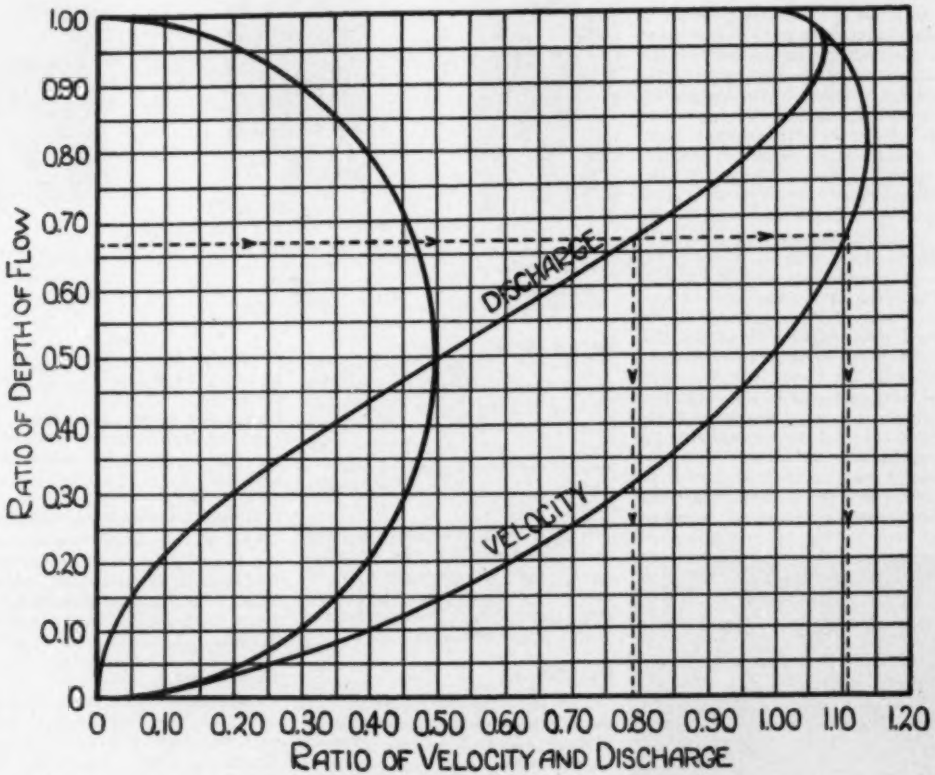


Fig. 2—Velocity and Discharge for Partially Full Circular Sewers
(Comparison of the filled section to the full section from Manning's Formula)

Example: If velocity = 2.4 ft./sec. and discharge = 4.9 mgd. flowing full; *then* flowing ⅔ full the velocity will be 2.4 × 1.11 = 2.68 ft./sec. and discharge will be 4.9 × 0.79 = 3.79 mgd.

Symposia Featured at Pa. Sew. & Ind. Wastes Meeting

23rd Convention in 25th Year

WITH a registration of 223, the 23rd meeting of the Pa.S & I.W.A. fell short of previous record attendance, but the caliber of the papers presented was certainly up to standard. Feature of the meeting were two symposia, one on sewage works, and the other on industrial wastes. This year, these symposia were held at different times, and not concurrently as had been the practice heretofore. As a result of this scheduling, attendance at both sessions was improved.

As usual, the meeting opened with a golf tournament and soft ball game, but this year the first afternoon also featured an inspection trip to the Limestone Mine of the Warner Co. at Bellefonte. One of the interesting points for observation was the source of water supply, which is a spring flowing 11.5 mgd. Water wheels powered by water falls are used to pump the water to the mine.

At the opening evening session, an address of welcome was given by Dr. H. P. HAMMOND, retiring Dean of Engineering at Penn State College. Dr. Hammond commented on the shortage of engineers and the particular need for sanitary engineers. Following the Dean's talk, two movies were presented, the first was "Waters of the Commonwealth" which had also been shown at the meeting of the Pa. Water Works Operators Assn. meeting earlier in the week. The other motion picture was "The Battle Against Rust" a commercial film showing the production and application of "Rustoleum" as a preventive coating for rust.

The Bunk House

Federation Affairs

At the annual banquet, the principal speaker was RALPH E. FUHRMAN, Supt. of Sewage Treatment, Washington, D.C., and current President of the Federation of Sewage Works Assns. Mr. Fuhrman commented on the present activities and growth of the Federation and called attention to the most recent publications, "The 20 Year Index" of Sewage Works Journal and the "Manual of Practice on Sewage Chlorination."

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Business Session

The report of Secretary Bush revealed 49 new members since the 1950 meeting, making a total of 377 members. Income and expenditures for the year were approximately the same, leaving bonds and cash on hand at roughly $1,132 and denoting a healthy financial status.

It was voted to establish a Legislative Committee with the immediate specific duty to determine what can be done to advance legislation which will provide Social Security for municipal employees.

New Officers

The following slate presented by the Nominating Committee (L. D. Matter, Chmn.) was accepted unanimously.

President
Robert M. Bolenius
Township Chemist, Abington, Pa.

Editor
J. R. Hoffert, Chief Engr.
Pa. Dept. of Health, Harrisburg, Pa.

Chas. H. Young, Div. Engr., Pa. Dept. of Health, is the Association's member on the Federation Board of Control.

Industrial Waste Symposium

One session was devoted entirely to the presentation of papers on industrial wastes. This session was presided over by ROY WESTON, San. Engr., Atlantic Refining Co., Philadelphia.

Pickle Liquor

"WASTE PICKLE LIQUOR TREATMENT AT THE BUTLER, PA., PLANT OF THE ARMCO STEEL CORP." by Grant A. Pettit, Industrial Waste Engineer, Armco Steel Corp., Middletown, Ohio.

Because of the recreational use to which the stream is put, all rinse

waters as well as pickle liquor wastes must be treated at this plant, which has been operating since 1945. Before the adoption of the present plant, several different methods of treatment were tried.

In this plant, all wastes and rinse waters flow to sumps, which serve to even out temperature, flow, and concentration going to the treatment plant. This diluted waste is pumped to the treatment plant by acid resisting pumps. Redwood tanks are used in the plant. Dolomitic lime hydrate is added to the first tank after which the mixture flows through four more tanks, from the last of which the sludge is pumped as a slurry to a lagoon. A Fischer and Porter Rotameter measures the flow, and a Leeds and Northrup pH control unit is used to record the pH of the slurry.

The flow varies from 450 to 1100 gpm. and averages 650 gpm. Lime is added only to the first tank and is recirculated to provide thorough mixing. At 1100 gpm. the total detention time is one hr. The pH is held at 8.5 to 9.0. The concentration of acid and iron varies and 10 per cent excess lime is added according to analysis and a chart reading.

The lagoon, now in use, covers 21 acres and holds 600,000 cu. yd. Clear water from the lagoon is used over in the main plant operations. For a waste treatment of 836,000 gpd. lime used totals 40,150 lb. or 1290 lb. per ton of acid. This treatment costs $23.09 per ton of acid neutralized or $0.54 cents per ton of steel pickled.

What to do with the sludge in the lagoon is the big problem. It does not dry out. Only the surface dries, and years later the bulk of the lime sludge is still semifluid.

"WASTE PICKLE LIQUOR AT WALKER OF CONSHOHOCKEN" by C. J. Lewis, Technical Director, Warner Co., Devault, Pa. and W. A. Cubberly, Gen. Supt., Walker of Conshohocken.

The Walker Co. makes electrical equipment such as conduits. Pickling is done by batch process using sulfuric acid. The sludge from the neutralization can not be handled at the local sewage treatment works, nor can it be lagooned because of lack of space. Therefore a method of mechanical dewatering of the sludge was adopted.

The treatment employs the dry lime addition technic. Two 7800 gal. tanks are alternately used, daily. These are filled from a 10,000 gal. equalizing tank. Lime is added, the mixture stirred and allowed to stand. Supernatant liquor is decanted through drawoff pipes. The sludge which contains about 54 per cent water is moved by a screw conveyor to a FEinc string vacuum filter where remaining free water is removed. The sludge is then transported to a dump. This filtered sludge has about 50 per cent moisture but dries quickly when used as a fill for low areas.

For each 100 lb. of sulfuric acid, the process requires 110 lb. of hydrated dolomitic lime. The sludge consists of 56 per cent calcium sulfate, approximately 24 per cent iron oxide, 16 per cent of magnesium oxide and a small amount of silica. The effluent from the process is crystal clear, but contains about 3400 ppm. of dissolved solids, mostly calcium and magnesium sulfate. The pH is 9.1, the alkalinity 80 ppm., the oxygen consumed 45 ppm. and the iron content 1.2 ppm. While this treatment works well for batch process operation, Mr. Lewis believes that it may be too expensive for continuous filter operation.

JOHN H. HARPER, Vice President, Industrial Wastes, Inc., Beaver Falls, Pa., discussed the topic of pickle liquor treatment; explained how he had formed a company for the purpose of treating pickle liquor from several plants for treatment in a central treatment plant. The waste liquor, without any rinse water, is transported in rubber lined tanks.

Fed. S. & I. W. A.

President
R. E. Fuhrman
Supt.
Sew. Tr. Wks.
Washington, D.C.

Pa. Director
C. H. Young
Div. Engr.
State Health Dept.
Harrisburg, Pa.

Treatment is by straight neutralization using ground limestone slurry. The batch process is used with the final slurry going to a lagoon where it is settled.

DR. THOMAS F. REED, Chem. Engr., United States Steel Co., Pittsburgh, Pa., also discussed the topic of pickle liquor treatment. Dr. Reed called attention to the fact that there is no general solution to the problem. There is much work yet to be done and still no suitable answer. At present, the costs of treating the pickle liquor wastes are as great as the original cost of the fresh pickling acid used. The settling rate of the sludge produced is slow, it is hard to dewater, it needs large areas for ultimate disposal, and there is no market for it. In spite of these difficulties Dr. Reed is optimistic that an ultimate solution will be found.

Phenol Wastes

"PHENOL DESTRUCTION BY CHEMICAL OXIDATION" by John E. Kinney, San. Engr., Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.

Mr. Kinney reviewed the cooperative study of laboratory and pilot plant operation on the treatment of phenols in coke oven ammonia still wastes at the Armco Steel Corp. plant in Middletown, Ohio. Cooperating in this project were American Rolling Mill

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High Hat Presentation
Fed. Prexy Receives Accolade from H. E. Moses of Sludge Shovelers Society.

Sludge Shovelers' Society

H. E. Moses, (Pa. Cons. Ch. Engr.) inducts H. P. Hammond (Ret. Dean of Engr., Penn State) and Harry Beaumont (Ch. of Ind. Wastes, Phila.)

Co., Wallace and Tiernan, Ozone Processes Co., Mathieson Chemical Corp., Dow Chemical Co., Ohio River Valley Water Sanitation Comm., Ohio State Dept. of Health, and U.S. Pub. Health Service.

The results of this study were presented at the Purdue Industrial Waste Conference in February 1951 and were reported on page 237 of the May 1951 issue of *Water & Sewage Works*. The results are reported there. (One error appears in that report, it states that 18 hours are required for the treatment with chlorine dioxide. This is not true, reaction is almost immediate—the 18 hour period mentioned refers to the determination of the phenols by the Gibbs method, which was discarded for the faster distilled amino antipyrene method.)

A complete report of the experimental results has been published by the Ohio River Compact Commission.

"Biological Treatment of Phenolic Wastes" by C. F. Garland, San. Engr., Infilco, Inc., Tucson, Ariz.

Mr. Garland reviewed some of the results reported in the literature on the subject of biological treatment of phenols, remarking that the results varied widely as to the concentration that could be applied on filters.

The cost of trickling filters for phenol treatment is high because of the large land area required, but high rate trickling filters and activated sludge treatment offer possibilities of cheaper but effective treatment. For this reason Mr. Garland believes that this type of treatment should receive a new appraisal.

He cited the results obtained at the phenol treatment plant of the Dow Chemical Co. at Midland, Mich. A combination of trickling filters and activated sludge treatment in series is employed at this plant. In another plant treating oil wastes, it has been found that the waste must have prior treatment before it can be discharged to the trickling filter.

Mr. Garland described a treatment plant of the Gen. Amer. Trans. Corp. where the wastes from the washing of oil tanks is treated. This plant employs a combination of adsorption on finely ground coal followed by flotation to remove the coal. The effluent from the flotation process is treated with ferrous sulfate and lime, aerated, settled in a clarifier, discharged to a lagoon, and thence to a trickling filter. The phenol in the raw waste is from 20 to 30 ppm. The final effluent contains 1 ppm. or less. Even raw waste concentrations of several hundred parts per million are successfully treated by the process.

Activated Sludge Problems

"Operating Experiences at the Activated Sludge Plant of Meadville, Pa." by Dewayne Day, Chief Operator, Sewage Treatment Plant, Meadville, Pa.

In his well prepared and clearly presented paper, Mr. Day recounted operating experiences and difficulties at Meadville, where bulking of the activated sludge has resulted in the rise of sludge index from 114 in 1948 to 331 in 1949, necessitating the reduction of sludge solids carried in the aerators from 1750 ppm. in 1948 to 907 ppm. in 1949; and, with a further reduction to 768 ppm., in 1950, even though the air input was 0.94 cu. ft. per gallon in 1950 as compared with 0.95 cu. ft. per gal. in 1948. In each year the theoretical aeration period was 8 hours.

Bulking of the sludge and poor settling quality justified a trial of return sludge chlorination. The effectiveness of this scheme of increasing sludge density was evidenced by the reduction of sludge index from 378 to 100 in a period of 10 days. However, the appearance of the final tank suffered from the grease-like scum which was apparently released from the bulky sludge found to contain 19 per cent grease on a dry basis. Repetition of sludge chlorination each time brought down the sludge index.

Mr. Day pointed out that a fluffy (bulky) sludge produced a high grade and attractive appearing effluent but that a plant operating with bulky sludge had to be too carefully watched and that a reserve of sludge capacity for shock loads dictated a more highly aerated sludge on practical grounds, and also for the operator's peace of mind. In addition, foaming of the aeration units had come to be a problem without any correlation with suspended solids carried.

In digester operation return of supernatant from the two secondary units to the heated (85°F) primaries had been practical to maintain a total alkalinity of 2000 ppm. or better. Digester capacity is 6.5 cu. ft./capita. Sludge is removed from the sand-beds by farmers now eager for it at no cost, the city's gain being the labor saved in sludge cake removal.

The primary settling tanks are too large and particularly does the sewage and wasted activated sludge deteriorate during the low night flows. Prechlorination is consequently a benefit in suppressing anaerobic decomposition and reducing odors. It is now proposed to return final effluent to the raw sewage during low flow periods to freshen the sewage and reduce the detention period in the primary units. Gas engine power is used to drive one blower during day hours, but the plant operates on purchased electric power during the night when it is without an attendant.

The necessity for improved laboratory control became evident in 1949 when 24 hour automatic sampling was introduced and laboratory tests were made 5 days a week instead of one day per week. Maintenance of a final effluent averaging 15 parts B.O.D. and 7 parts suspended solids since the advent of daily sampling and testing Monday through Friday proved ample evidence of the need for increased laboratory control of activated sludge plants. (And, may we add, intelligent interpretation of laboratory findings, as was evident at Meadville. —Ed.)

To maintain an oxygen balance through the plant the sludge is returned from the final tanks in a relatively dilute condition, and in a ratio of 40 volumes of dilute sludge (2500 ppm. solids by wt.) to every 100 volumes of sewage treated. This is one half the concentration of sludge returned in prior years when 1750 parts (dry basis) could be carried in the aeration units. Previous procedure of maintaining a constant air input, and varying the solids carried in the mixed liquor to maintain an oxygen balance, has had to be abandoned of late and the air input increased, with the result that subsequent reports will show a greater air requirement than the 0.95 cu. ft. per gal. found to suffice in the past. (A study of the operating and analytical data for the Meadville plant

Sewage Treatment

Dewayne Day
Operator
Sew. Tr. Wks.
Meadville, Pa.

Harry Foth
Mgr. and Supt.
Sew. Tr. Wks.
Mechanicsburg, Pa.

reveals conclusively the value of improved laboratory control, with analytical results intelligently applied, during the past two years. Mr. Day deserves a rating of "excellent" for attainment as well as clarity of reporting.—Ed.)

PAUL N. LONGLEY, Supt. of Treatment at the Radnor-Haverford (Pa.) plant, in discussion disclosed the successful use of return sludge chlorination at his plant, where the returned sludge is chlorinated at the rate of 6 ppm. The scheme has been successfully applied for three years.

G. A. Pettit
Ind. Wastes Engr.
Armco Corp.
Middletown, Ohio

C. J. Lewis
Tech. Dir.
Warner Co.
Devault, Pa.

T. F. Reed
Chem. Engr.
U.S. Steel Co.
Pitts'urgh, Pa.

Pickle Liquor Treatment

High Rate Filter Experiences

"EARLY OPERATION EXPERIENCES WITH TWO-STAGE HIGH RATE FILTERS" by Harry Foth, Sewage Works Manager, Mechanicsburg, Pa.

Hearing the paper presented by Mr. Foth proved a delightful experience in that it revealed highly intelligent understanding and operating ability of a retired farm-equipment salesman pressed into service by brother members of the Sewer Board of Mechanicsburg who found themselves up against the problem of securing a qualified plant operator.

Mr. Foth, finding "sewage treatment an intriguing hobby," has apparently learned more about sewage treatment in 11 months than many know after several years. He constitutes the one-man force operating Mechanicsburg's relatively new two-stage Bio-filter plant, with separate sludge digestion. After the usual headaches of breaking in the plant, removing timbers, etc., from pipe-lines and valves, adjusting this and that, the Mechanicsburg plant can boast a 99.5% removal of settleable solids through the primary tank and 96.4% overall removal of B.O.D. With a recirculation ratio of 2 parts effluent to 1 part settled sewage the plant effluent contains but 2.5 ppm. suspended solids and a B.O.D. of only 10.9 ppm.

From the center cone of the final clarifier 10% of the flow is taken for return to the crude sewage. The mixed sludge (humus and crude) averages 3.5 per cent solids; digested sludge 6.5 per cent.

Relating some of his problems, Mr. Foth thinks that bed-plate gaskets for sewage plant equipment are too light and could well be of the automotive type of gasket material. Filter ponding need not have happened if the contractor had been prevented from using poorly graded stone and fines. He recounted his daily routine of equipment lubrication and the required laboratory work, involving solids determination daily, tests for dissolved oxygen and stability twice weekly. B.O.D. once each week. Every two weeks the troughs and weirs are scrubbed down. Comminutor teeth and combs are changed for re-sharpening every two months for best performance.

In the discussion which followed, President-elect BOLENIUS expressed the opinion that some simpler test than the B.O.D. test should be perfected for use in routine plant control. A chemical oxygen demand test with a factor for conversion to biological demand value did not seem impracticable for cutting down on the frequency of the tedious B.O.D. test. He said he wanted to throw this idea to the State Dept. of Health engineers for consideration. It would mean that a greater number of oxygen demand tests could be made and quicker results would guide the operator to better advantage.

Phenol Wastes

J. E. Kinney
San. Engr.
ORSANCO
Cincinnati, Ohio

C. F. Garland
San. Engr.
Tufico, Inc.
Tucson, Ariz.

Corrosion Protection

"CORROSION PROTECTION OF SEWAGE WORKS STRUCTURES" by W. T. McClenahan, Principal Construction Engr., Sanitary District of Chicago.

Mr. McClenahan, who has come to be an expert on paint and protective coatings for sewage works structures, presented a condensed version of a voluminous paper on this important phase of sewage works maintenance. We can nont do the subject justice in a digest of a digest. However, it can be stated that Mr. McClenahan put great emphasis on the preparation of surfaces for painting and the prime coat. He pointed out that hydrogen sulphide gas is highly penetrating and that the paint vehicle is therefore more important in sewage works than elsewhere. As to inhibitors in prime coatings, chromates seemed to be the best, and also better than red-lead for spotting. The prime coat should contain 30 to 35 per cent pigment and powdered mica adds materially to imperviousness.

For the metal parts of vacuum filters, vinyl coatings had proved best. For the underside of tank roofs and wherever moisture condenses (screen chambers, etc.) chromate coatings had proved superior. Bituminous coatings stand up well but require a two week drying period. Paints with a fish-oil base have the advantage of good wetting quality, but in his opinion linseed oil is to be preferred in most cases.

In surface prepartion for painting, sand-blast is superior but can frequently not be used because of dust danger to equipment bearings, etc. In many cases flame cleaning is too hazardous around sewage plants. Therefore, wire-brushing, scraping and washing are mostly used. Some of the unsolved problems include a putty that will stand up, a coating that will not heat-blister and a paint which will not permit dust to accumulate on wall surfaces.

In answer to a question concerning waterproofing walls, the only certain method he said was to apply the coating to the side on which the water lies. As to cement base paints he considered them good, provided acidic conditions did not prevail.

Mr. McClenahan's paper is a veritable hand-book on painting practices at sewage plants, based on many years of experience and experimentation. It will doubtless become available in the Federation Journal or in the form of a Federation Manual.

Trickling Filter Loading

"LOADINGS AND PERFORMANCE OF HIGH RATE TRICKLING FILTERS OPERATED IN SERIES AND IN PARALLEL" by H. Hukelekian, Prof., and M. C. Rand, Res. Assoc., N.J. Agri. Expt.

Sta., Rutgers Univ., New Brunswick, N.J.

The paper was read by Mr. Rand who pointed out that the literature contained little information of the subject of parallel versus series operation of trickling filters. There are a number of double filtration installations, particularly in England, but little data on comparison of the two methods of operation.

This paper reported on two years of parallel operation and two years of series operation of a pilot plant treating a domestic waste containing about 10 per cent industrial wastes, mostly sugar having a high soluble B.O.D. The pilot plant was operated only in the summer months of each year. Loadings were varied for each type of treatment. The raw B.O.D. for parallel operation was about 535 ppm. on the average while that for series operation was 610 ppm.

Actual loadings were varied from 1.0 to 5.4 lb. of B.O.D. per cu. yd. of stone in each set of experiments. When the filters were operated in parallel, with a loading of 1.0 to 3.0 per cu. yd., the effluent ran from 51 to 97 ppm. for a removal of approximately 80 per cent. Above 3.0 lb. per cu. yd. the removal averaged about 70 to 65 per cent.

In series operation, for a loading of 1.0 to 2.5 lb. per cu. yd. the effluent had 21 ppm. of B.O.D. and the average removal was above 96 per cent. Thus the efficiency of series operation is 2.5 times that of parallel operation up to a loading of 2.5 lb. per cu. yd. Above a loading of 2.5 lb. per cu. yd. the efficiency of series operation decreases in somewhat parallel rate to that of single stage operation but always remaining higher for the two stage than for the single stage. Recirculation was practiced in both treatments, the rate being about three times in parallel operation and from 7.5 down to 2.0 times for two stage operation. The B.O.D. of the mixed liquor applied was from 75 to 100 ppm. The hydraulic loading was 27 mgad.

Philadelphia Experiences

"Starting Up Experiences at Philadelphia" by Ralph Hoot, Supt., Sewage Disposal Plants, City of Philadelphia.

Lyman Cox
Eng. Serv. Div.
Du Pont
Wilmington, N. C.

W. T. McClenahan
Prin. Cons. Engr.
San. District
Chicago, Ill.

R. A. Hoot
Supt.
Sew. Disp. Plts.
Philadelphia, Pa.

Programmers

Mr. Hoot told of the problems of getting the new Northeast Plant into partial operation. The new plant has activated sludge and sludge digestion. Fortunately the old Imhoff tanks at this plant made it possible not only to start the new units as they were finished but also provided a place to dump soured sludge when the new units became septic.

One of the big problems of starting up was the lack of personnel, a condition which still exists. First operation of one settling tank, and one aeration tank but no digestion tanks (the sludge went to the old Imhoff tanks) began on April 6. Some 20 mgd. were treated using 0.7 cu. ft. of air per gal. of sewage. At the end of August they were using two of the six units and treating 50 mgd. at 0.45 cu. ft. of air per gal.

Return sludge amounts to 15 per cent of the flow and this being a modified aeration type of treatment plant only 200 ppm. of solids are carried in the aeration tanks. The final effluent contains 33 ppm. of susp. solids and 33 ppm. of B.O.D.

Early problems were foam caused by detergents, and lack of equipment and operators. Operating difficulties were many and varied, some were amusing, most were not. Gradually the whole plant will be brought into operation and it is hoped that complete operation will be possible by Nov. 1. At that time, the new digestion tanks will be placed in operation and the old Imhoff tanks cut out of service. These new tanks will be heated by direct contact of hot gases with the sludge. One of the first jobs given to newly employed operators is to clean up the property, buildings and equipment. Mr. Hoot believes strongly in the importance of cleanliness as a means of furthering good public relations.

Industrial Wastes Disposal

"An Orderly Approach to Industrial Waste Disposal" by Lyman Cox, Engineering Service Division, E. I. duPont deNemours Co., Inc., Wilmington, Del.

According to Mr. Cox, the orderly approach to the problem is of greatest importance, and he quoted many examples of the disorderly approach as exemplified by some of the following wrong attitudes:

"Head in sand" or "let sleeping dogs lie."

"Foot dragging" or "defer the evil day."

"No waste to streams" or "pristine purity."

"Treat everything whether or not it needs it."

"Prior right" or "got here first."

"Been doing it for years, never had any complaints."

"Funds aren't available" or "the people won't stand for any more bonds."

"We have to have a new bridge" or "how about that new school."

"Clean up or shut down."

"No point in treating this little dab of sewage" or "let John do it."

"You'll never drive me out of business" or "what are you trying to do, give the country back to the Indians."

"You tell us how" or "we don't have time to be bothered."

The approach today is generally more intelligent and as a result is a lot more orderly.

The states have learned that good administration is of first importance and that getting together with technical men from industry to consider factual data is a good first move in

Between Sessions

any pollution problem. Industry has learned, too, that water is important, and that the public wants clean water.

With concern about the problems comes the realization that both government and industry are to blame and that both have a clean-up job to do. This has lead to recognition of responsibility by industry, but industry is sometimes reluctant to go ahead with the job. This is where the orderly approach is important. It has to include a good plan and a realistic goal on the part of the state, and good faith and hard work on the part of industry. This requires a decision on the part of management because pollution abatement or industrial waste treatment is a management problem because it involves the elements of finance, law, public relations, research, and administration. An industrial pollution control program must, of necessity, become a part of many other industrial endeavors or areas of specialized direction and effort. For industry then an orderly approach must stem from management policy, but it is dependent on good organization and able execution.

For a discussion of an organization program, Mr. Cox referred to a paper by R. R. Balmer, in the March 1949 *Sew. Wks. Journ.* And for a good outline for developing the necessary information, he referred to a publication of the Manufacturing Chemists Assn., entitled "Manual W-1, Organization and Method for Investigating Wastes in Relation to Water Pollution."

The "orderly approach" is a must if industry is to get the needed improvement without incurring excessive costs. The key to the matter is to determine what are the wastes and where they come from and then set out to reduce individual sources.

It isn't enough to do just a good job, industry must let the public know about it. In trying to get the story across to the public, efforts made to educate employees will pay off. It is important to deal with the press in good faith at all times, not only in pollution matters, but in all matters.

Mr. Cox not only spoke on the subject of wastes from existing plants but he also outlined what should be done to approach a waste problem for an entirely new plant or a plant addition.

Mr. Cox concluded with the comment that the efforts to eliminate industrial waste by an orderly approach to the problem are well worth while. Two indispensable factors in that approach are (1) Good laws supplemented by good regulations and able administration, and (2) An active industrial program based on good faith and able execution.

Strohmeyer Made Water Engineer of Baltimore

Joseph S. Strohmeyer, former Deputy Water Engineer of Baltimore, Md., has been appointed Water Engineer. He succeeds Leon Small who has retired after serving as Water Engineer for 16 years.

To fill the position of Deputy Water Engineer, Bernard L. Werner, formerly Principal Associate Engr., has been promoted.

Mr. Strohmeyer is a life member of the American Water Works Assn., and longtime active in the Chesapeake section of A.W.W.A.

New York's Newest Sewage Plant to be Inspected

New York City's Owl's Head sewage treatment plant, whose design incorporates a number of "firsts" in this city's sewage treatment construction program, will be the subject of inspection and discussion by the Metropolitan Section of the N.Y. Sewage and Industrial Wastes Association to be held Oct. 16, in New York City. S. W. Steffanson, project engineer for New York City's Department of Public Works, will guide the inspection tour of the plant and will deliver a paper on details of its construction.

This plant has been designed exclusively as a "high-rate" activated sludge plant, known more commonly as "modified aeration." It is the first to enclose and ventilate the aeration and settling tanks, and to ozonate the exhaust air as an odor-control measure. The plant has the first of the retractable air diffuser tubes, the first prestressed digestion tank, and the first Parshall metering flume to be used in a New York City plant.

Because of the unusual location of the Owl's Head Plant, it has been especially designed to avoid possible odor nuisances.

Chain-Drives*

What do you know about this efficient, economical transmission?

A capable engineer has recently stated to this writer that he finds himself an ardent chain-drive "fan." He cites the following reasons which will probably be of interest to many readers of *Water and Sewage Works.*

Like gears, chains provide a positive and unvarying drive ratio. They make it possible to regulate accurately the speed of conveyors, agitators, etc. But, unlike gears, they are not so stiff and unyielding. Chain-drive lends itself ideally to many types of equipment.

Most readers doubtless know that the efficiency of a first class chain-drive is high. But, it is not so well known that even the less expensive types, the heavy link-belts such as used on some machines, have a high efficiency — surprisingly high. In fact, the efficiency of these drives is usually so close to 100% that the power loss is of no consequence whatever. However, efficiency of transmission is usually of less importance than dependability.

The first cost of chain-drives of the link-belt type is moderate. In the weighted costs must be reckoned the freedom from "dead" machine time, the lower interest on the smaller investment, the simplicity of installation, and low maintenance cost.

Chain-drives have great strength and durability. They do not wedge or bind. Slight sprocket misalignments have no noticeable effect on performance, efficiency, or life. These latter points are of greatest importance on certain types of machines or equipment, as most users will doubtless agree. A drive that is as rugged and dependable as the chain drive, and at the same time is so efficient and easily repaired, is bound to be economical in the long run.

*A contribution of W. F. Schaphorst, M.E., Newark, N.J.

—but, Think of the Good Drainage

"Well, maybe the water cistern may get a little low up here at times. But, just think of the fine drainage—no wet basement or clogged sewer up here."

SAVANNAH'S new "Sewe-Roder" in action, flexible-rodding through coil spring guide hose entering sewer that runs at 90° angle to truck position.

The Savannah Sewer Story 1847-1951

by HENRY W. JENKINS, *Supt. of Constr. and Maintenance, Engineering Dept., Savannah, Georgia.*

IN April 1846 Alderman Timothy G. Barnard, Chairman of the Health and Cemetery Committee, presented a detailed report to the Council of the City of Savannah, Ga., in which he advocated a policy of re-vaccination of Savannah citizens every eight or nine years to combat the threat of smallpox. As a result of this report a sewerage system was recommended as "likely to greatly increase the healthfulness of the city." By 1847 the Perry and West Broad St. sewers were under construction. During the following decade additional sewers were added and by 1858, ("the value of sewers definitely appreciated,") Council directed a sewer to be built in Liberty St., 5,800 feet long, 3 by 4 feet, at a cost of $13,200. In 1859-60, $17,600 was expended on a sewer in Perry Lane, eastward from Whitaker Street.

However, it was not until August 12, 1896 that the City Commission recommended the adoption of the comprehensive plan outlined in a report by Col. W. J. Winn, City Engineer. The plan, as stated by Col. Winn, would serve a population of 200,000, and the estimated cost of the outfall and sewers was $136,-682.45.

The City of Savannah originally was ideally situated on a ridge, with all lateral sewers draining to the low areas where the sewage was collected in canals. This ridge, or plateau, with an elevation ranging from 25 to 45 feet above low water, created various construction problems. Because the ridge was bounded on the north by the large Savannah River and the east and west by low areas the interceptor in the south carried sewage from the west to east, through the high part of the ridge, for discharge in the river eastward of the city in order to avoid contamination of the city's water supply. This coastal area consists largely of sand frequently underlaid with both hard pan and marl that created construction problems of serious consequences. In deep cuts this condition causes two water tables, one above and one below the impervious marl. Holding two areas of water in check while attaining a dry bottom for laying sewer pipe presented a serious problem of controlling shifting watery sand.

The engineering firm of Waring, Chapman & Farquhar, of New York, were selected as consulting engineers and were paid 7% of the cost of the contract. Under the terms of the contract and bids the entire job was to be completed by December 31st, 1898. Due to financial difficulties encountered by the original and subsequent contractors, who could not cope with the sand and water conditions, the city was forced to take over the contract and complete the sewer system under the direction of the Public Works Department. The construction and maintenance of storm and sanitary sewers is now under the direction of the Engineering Department.

Savannah's System as of Today

The city gradually expanded in a southerly direction; and, with this development continuing through World War II, in January 1950 the city retained the firm of Wiedeman and Singleton, of Atlanta, and Thomas and Hutton, of Savannah, as consulting engineers to make a survey of all sewers and to plan for future development. However, with housing projects being erected on reclaimed low areas the planning for the future soon became actual conditions and construction is going forward at this time.

W. F. Shellman, City Engineer, pointed out that approximately 50% of the streets in Savannah are paved. The new housing projects have approximately 100% paved streets and this condition has caused an overload on existing sewers by greatly increasing the degree of surface water runoff.

To combat this condition plans

SAVANNAH'S BATTERY of the latest in sewer-cleaning units ready for action—and, it might also be added, for a newspaper story on bettering sewer maintenance in our city.

have had to be revised to divert surface drainage in a southerly direction rather than to the Savannah River to the north. The solution of this problem will greatly relieve combination storm and sanitary sewers that must carry greater burdens as additional paving is completed in the older areas of the city.

The City is under contract with the Espy Paving and Construction Co., of Savannah, for a $750,000 sewer project, as well as the Dixie Construction Co., of Savannah, for a similar project and amount. The Acme Construction Company, of Mobile, Ala., have been awarded the contract for the Treatment Plant with a capacity of 2,500,000 gallons per day. This contract has been let for approximately $700,000.00. The plant will be under the direction of Mr. Paul Helmly.

Maintenance Problems

During the period from 1847 to the end of World War II the City of Savannah coped with the problem of roots and sand in its sewers with whatever tools were on hand, and in many cases was forced to dig sewers when stoppages had occurred in pipes that were in good physical condition. Methods of 'panning' sewers were developed but it was slow hard work for the men down in the man-hole pushing rods. Some of the old sewers had developed leaking joints and methods of cleaning by flushing with water pressure were abandoned because of the resultant cave-ins. It became very evident that some methods must be found that would remove roots and sand without the use of water or with what could be termed a "dry cleaning method."

During the year 1948 the city purchased their first modern sewer cleaning equipment. A set of Flexible Power Bucket machines was purchased and a crew was set up to clean the main outfall sewers. These machines were so successful in removing sand from the large sewers that the city decided to try them on the smaller feeder lines. While this

POWER BUCKET MACHINES set up on Congress Lane sewer pulling 6 inch bucket through 8 inch line.

was a start in the right direction one crew could not do a thorough maintenance job on the existing system in addition to the areas that were being developed.

Record Order of Maintenance Equipment

The expense of replacing sewers that were overloaded was prohibitive and the decision to purchase additional sewer cleaning equipment was made late in 1950. The City of Savannah, after due consideration, placed what is thought to be the largest order for sewer cleaning equipment ever delivered within the continental United States. The order was placed with the Flexible Sewer Rod Equipment Co., of Los Angeles, in January 1951. The equipment, requiring a full freight car for shipment, was put in operation during early March 1951.

The equipment consists of two Flexible Power Bucket Machines equipped with 8 h.p. Briggs Stratton motors; two Flexible Power Bucket Machines equipped with 21 h.p. air-cooled Wisconsin motors; two complete standard sets of Flexible Steel Rods with Flexible Power Drives and one "Seweroder," complete with 487 feet of Flexible Steel Rods.

The bucket machines are being used to remove sand from lines 8 inches to 72 inches in diameter. Each bucket unit is equipped with a complete set of buckets from 6 through 22 inches. The size of the opening of the manhole ring determines the size of the largest bucket that can be used.

The standard sets of Flexible Steel Rods with the Power Drive are used for rodding sections of sewer from manhole to manhole and pulling cables back for setting up the bucket machines. These rods are also used for maintenance of 6 and 8 inch lines where roots are encountered and must be removed.

The "Seweroder," which is the latest machine developed for sewer maintenance, is as fully automatic as possible and is used almost exclusively for emergency stoppages. This machine is capable of carrying 1000 feet of Flexible Steel Rod in its enclosed reel. The "Seweroder" (see picture) rotates the rod, takes it off the reel and feeds the rod into the sewer. When the cleaning operation is completed the rod is pulled and automatically re-wound on the reel. A footage meter enables the operator to know exactly where the corkscrew at the head of the rod is at all times. Through the use of a variable speed clutch the operator can increase the speed from a slow forward movement up to 125 feet per minute. We have mounted the "Seweroder" on a truck for maneuverability and faster transportation to emergency jobs.

This new equipment, in addition to the two units previously owned by the city, is operated with a crew of three men to each pair of bucket machines, three men to the "Seweroder." Each bucket machine crew first rods the sewer for pulling back the cable for attaching to the bucket.

Results

Since this preventative maintenance program has been put into effect the Engineering Department handles an average of 2 to 3 stoppages per day. Previous to 1948 the Department records show an average of 5 to 6 stoppages per day. With the use of the new equipment the time for opening the average stoppage has been reduced by better than 50%. Under conditions using the previous equipment the Department records show 65 to 70 percent of the stoppages resulted in sewer dig-ups. This condition occurred where it was impossible to reach the trouble with old style rods from the existing man-holes—or else, having reached the stoppage could not dislodge it with the old style rods.

Our Engineering Department now operates this additional equipment within the financial framework of the 1950 budget. Not one additional man has been added to the total number of laborers. On the contrary, where crews formerly averaged 5 to 6 men, two laborers and a foreman now comprise the cleaning crews.

It can be conservatively stated that the system of preventative maintenance now carried on has increased the efficiency of the sewer cleaning crews by 75%. In addition there is an uncalculated increased efficiency of the sewer system.

The staff of the Engineering Department of Savannah is as follows:
Norris Sherry, Director of Building and Engineering
W. F. Shellman, City Engineer
Henry W. Jenkins, Supt. of Construction and Maintenance
Louis Cornell, Field Superintendent
Paul K. Helmly, Supt. Treatment Plant

POWER BUCKET MACHINES of 21 H.P., with buckets of 6 to 22 inch diameter, operating on Henry Lane sewer

Mono- and Dichloramine Determinations in Water

By the Palin Method and the Amperometric Procedure

(The First of Two Installments.)

by DON. B. WILLIAMS, *Chemist in Ch'g. of Water Purification, Brantford, Ontario.*

THE more widespread use of free residual chlorination in water works practice to insure maximum disinfection, to aid in taste, odor and color removal, and to improve coagulation, places an even greater emphasis on the role of chlorine in water works practice than heretofore.

It is not surprising to find that the application of the newer chlorination techniques is being met by an increasing search for new knowledge concerning the reactions between chlorine, or rather its compounds, and the varied types of substances found in raw waters. To increase our knowledge in this field we must have improved methods for determining the end products of such reactions.

The history of methods for determining "residual chlorine" in water is an interesting subject in itself. Palin[1] in describing his new method for determining free chlorine, monochloramine, dichloramine and nitrogen trichloride in water reviews this history in fair detail for the purpose of indicating the inadequacies in procedures in use up until the time of his writing—February, 1949.

Particularly, he shows that Harold[2] and Calvert[3] were aware that when thiosulfate titrations, employing starch iodide, were made on samples containing chloramine, variations in results were found dependent on the titration being carried out under neutral or acid conditions.

According to Palin, Harold came to the conclusion that the titration performed under neutral conditions represented monochloramine whereas on the addition of acid, further amounts of "available chlorine" could be titrated; this was assumed to be dichloramine. By the use of his procedure, described later, Palin believes that he has confirmed Harold's work.

Palin discusses the orthotolidine solution in use prior to the acid-orthotolidine of 9th edition of "Standard Methods."[4] He shows, from Chamberlain,[5] indistinct results due to formation of varying mixtures of yellow holoquinones and blue meriquinones dependent on the pH of the water under test.

For this reason the acid-orthotolidine of the 9th edition "Standard Methods"[4] was developed to be used in such manner that correct pH and sufficient excess of orthotolidine were present to insure developments of only yellow holoquinones in the presence of free and combined chlorine. The acid-orthotolidine for all practical purposes developed a yellow color instantaneously in the presence of free chlorine whereas time was required in the case of chloramine. This led Hallinan[6] to develop the "O.T.A." procedure employing arsenite to prohibit any further color development after free chlorine had reacted.

This procedure will undoubtedly remain of great value in routine application of free residual chlorination. It does have certain shortcomings, among which is the fact that a true chloramine, in the absence of any free chlorine, does give varying degrees of immediate yellow color dependent on temperature, magnitude of chloramine residual present, and ratio of NH_3 to Cl_2. Using the O.T.A. procedure, it is apparent that some chloramine will always be reported as free chlorine even though by other methods it is known that free chlorine is absent. Palin describes the reaction between arsenite and chloramine as incomplete giving rise to errors amounting to possibly seven percent. Palin also points out that acid-orthotolidine gives no indication of the percentage of monochloramine and dichloramine existing in any particular chloramine residual.

Palin's general criticism of acid-orthotolidine is basically true and in this regard it is expected that he will be agreed with widely. Also, his opinion as to why we should know more about the two fractions making up the chloramine are very real and this should find wider application not only in research but also in plant control.

Palin criticizes the amperometric procedure of Marks and Glass.[7] His remarks are based on that period when Marks and Glass and their associates were employing sodium arsenite as the titrating medium for both free chlorine and chloramine, potassium iodide being applied after the free chlorine titration so as to estimate the chloramine, the whole being conducted at pH 7, a buffer being used for that purpose.

Apparently Palin did not realize that the early work of Marks and Glass has resulted in the Wallace and Tiernan Amperometric Titrator with its improved technique. The sodium arsenite, inefficient at certain pH ranges, has been replaced by phenylarseneoxide, efficient over a wide pH range. The free chlorine continued to be titrated at pH 7 or at whatever pH was present at the time the sample was taken. To give a true figure for total chloramine it became necessary to reduce the pH to 4, a buffer being provided for this purpose, iodide also being added. These refinements were certainly in effect at the time of Palin's writing.

Palin's work encouraged Marks, Williams, and Glasgow[8] to make further refinements in the amperometric procedure so that the amperometric procedure may now be used to accurately determine the percentages of free chlorine, monochloramine and dichloramine in water. This new aperometric procedure has recently been announced[8] in a paper which outlines its accuracy, evaluates the Palin procedure, and briefly shows the importance of such advanced procedures. It is of particular interest to note that Marks, Williams, and Glasgow worked on pure solutions of chloramine in the laboratory and their work was cross-checked in the author's laboratory on chloramine in water resulting from plant operation. In this regard it seemed of importance to tie up theoretical considerations with the practical.

The Palin Method

In the following sections the Palin Method, its technic, interferences, and evaluation are presented.

An article prepared especially for *Water & Sewage Works*, based on cooperative research conducted in the author's laboratory and the laboratories of Wallace & Tiernan, Inc., Newark, N. J.

Solutions Required

(1) 4% solution of sodium hexametaphosphate, C.P.

(2) Neutral orthotolidine. Dissolve 1.35 gram orthotolidine dihydrochloride in 1 liter of ammonia- and chlorine-free distilled water.

(3) 0.1% solution of potassium iodide, C.P.

(4) 0.5% solution (by volume) of sulfuric acid, C.P.

(5) 5% solution of sodium bicarbonate, C.P.

(6) Carbon tetrachloride, C.P. tinted to faint pink with iodine to satisfy its "chlorine demand."

(7) Standard solution of ferrous ammonium sulfate solution (F.A.S. solution); 1 ml.=0.1 mg. Cl. Dissolve 1.106 gram C.P. reagent in distilled water containing 1 ml. of 25% (by volume) H_2SO_4, then make up to 1 liter with freshly boiled and cooled distilled water.

This writer prefers to use ammonia- and chlorine-free distilled water made by redistilling distilled water in the presence of sulfuric acid. The distillate is stored in tightly closed bottles and is very suitable for making up these solutions and flushing the required glassware.

Palin used A. R. grade chemicals supplied by British Drug Houses, London. To evaluate his procedure the same brand of chemicals was used.

Quantities

Palin suggests 100 ml. samples. On this size sample, 5 ml. of each preparatory reagent is sufficient for samples containing up to 5 ppm. available chlorine. Quantity of reagents may be reduced when it is known that residuals are lower; for example, up to 2 ppm. available chlorine use 2 ml. of each reagent.

Larger samples may be used if found desirable, increasing the amount of reagents accordingly, calculating the results on the basis of 100 ml. samples. Dilution of samples very high in chlorine content is best accomplished by adding the required amount of distilled water to reagent (1) and (2) prior to adding sample.

For a 100 ml. sample, 1 ml. of the F.A.S. solution=1 ppm. chlorine. In the following section on *Procedure*, the quantity of reagents to be used is to be determined by the above discussion.

Procedure

Add the sodium hexametaphosphate solution and then the neutral orthotolidine solution to a flask. A precipitate forms which disappears on shaking. Disregard lack of complete disappearance of the precipitate. Add sample, then swirl. If a blue color appears, titrate with F.A.S. solution, slowly near endpoint, to disappearance of the blue. Record as reading No. 1. (A 5 ml. micro-burette is well suited to this work.)

Add potassium iodide; swirl. If a blue color develops, titrate it to disappearance with F.A.S. solution. Record this additional amount of F.A.S. solution as reading No. 2. (Up to this point the sample has been at pH 6 or higher.)

Add sulfuric acid solution; swirl. This lowers the pH to approximately 3, permitting any remaining chlorine compound to become reactive to the iodide. Since a blue meriquinone will not form at this low pH the sample must be restored to substantially its original pH.

Therefore, add sodium bicarbonate; swirl. If a blue color appears, titrate with F.A.S. solution to disappearance. Record as reading No. 3.

If nitrogen trichloride (NCl_3) is known or suspected to be present, proceed as follows:

Extract a 100 ml. sample in a separatory funnel with 10 ml. of the CCl_4. Drain off the CCl_4. Run sample into flask containing the hexametaphosphate and neutral orthotolidine. If blue color develops, titrate with F.A.S. solution to disappearance of the blue. Record as reading No. 4.

Interpretation of Results

Reading No. 1—Free chlorine plus NCl_3 if any.
Reading No. 2—Monochloramine.
Reading No. 3—Dichloramine.
Reading No. 4—Free chlorine only.
NCl_3=1.5 × (Reading No. 1 minus reading No. 4).

The factor of 1.5 is applied since only part of Cl_2 in NCl_3 is available.

Interfering Substances

Palin has examined many substances likely to interfere including ferric iron and nitrites finding that only manganic manganese interferes. When such is present an additional procedure is required.

Two ml. of the hexametaphosphate solution, 2 ml. of the iodide solution and 0.5 ml. of an 0.5 per cent solution of sodium arsenite are added to the titration flask. 100 ml. of the sample is then added. At this point the arsenite has destroyed Cl_2 in any form. Two ml. of the neutral orthotolidine is then added, the blue color developing being entirely due to manganese. Titrate with F.A.S. solution to the disappearance of the blue, subtracting this result from reading No. 1 made in the normal way.

Discussion and Evaluation

The Palin method involves titration with standard ferrous ammonium sulfate solution using neutral orthotolidine hydrochloride solution as indicator with the proper buffers present. In neutral solution and in the absence of iodide, only free chlorine gives a blue meriquinone color which can be titrated with ferrous ammonium sulfate (residual chlorine present as NCl_3 also gives some of this blue color). In the same sample, at the same pH, when a definite amount of potassium iodide is added, monochloramine liberates iodine, producing further blue meriquinone color which is again titrated with ferrous ammonium sulfate. When the same sample is then acidified to approximately pH 3, the dichloramine then liberates iodine. The sample is then treated to restore pH to the neutral range, further blue meriquinone color is obtained and is titrated with ferrous ammonium sulfate to give the dichloramine.

When NCl_3 is present, it is said to appear in the first fraction. In Palin's method NCl_3 is determined by removing it on a second sample by means of extraction with CCl_4 and then determining only free chlorine on that sample. It is considered that CCl_4 removes the NCl_3 leaving the hypochlorous acid relatively untouched so that the difference between the two titrations after applying a correction factor of 1.5 is theoretically hypochlorous acid.

Palin based his conclusion that the three separate titrations represent the three species of available chlorine on a comparison with the neutral and acid starch iodide titrations. All other data to substantiate this conclusion are qualitative only. Since it has never been shown quantitatively that the neutral and acid fractions in the starch iodide titration represent in a clear-cut manner definite forms of available chlorine, it appeared highly desirable to test the Palin method on solutions, the composition of which regarding the various forms of active chlorine was known with considerable accuracy.

It has recently been shown[9] that Chapin's data giving the proportion of the several chloramines formed at various pH values is quite accurate for the concentration at which Chapin worked but does not hold when the concentrations are of the order of 1 ppm.

A series of experiments was carried out at concentrations of 100 ppm. to determine the pH values necessary to insure the presence of the desired chloramine. By extracting with chloroform and analyzing the chloroform layer for both nitrogen and chlorine it was found that at a total concentration of 100 ppm. available

chlorine, pure solutions of monochloramine can be prepared at pH 8.9 while substantially pure solutions of dichloramine can be prepared at pH 4.6. Solutions of monochloramine and dichloramine prepared in this way were used to carry out a series of experiments in which carefully measured amounts were added to demand-free water to give available chlorine concentrations in the order of 1 ppm. to which the Palin method was applied.

As a result of these experiments it is concluded that the Palin method is qualitatively correct. The hypochlorous acid appears only in fraction 1, monochloramine appears only in fraction 2, and the dichloramine only in fraction 3. When this test was made on solutions containing only hypochlorous acid the agreement between the Palin method and the calculated value of chlorine concentration was generally very good. Some fading of the end point was observed when the temperature of the sample was 25°C or above. When the solution contained only monochloramine, quantitative agreement could be obtained at temperatures in the range of 10 to 15°C but the results were poor in the range of 20 to 25°C. Here the fading was very pronounced and the amount found was in some cases as low as one-half of the theoretical. When the solutions contained only dichloramine the results were very erratic and it was not possible to get consistent agreement at any temperature in the range of 10 to 30°C. In all cases the fading of the color was quite rapid even though Palin's modification to prevent fading was applied.*

In a further test, solutions were made up in accordance with Palin's experiment No. 1, permitted to stand for 24 hours and then analyzed by his method and by the starch iodide method. In this case it was not possible to substantiate Palin's results mainly because there was again severe fading of the color. One possibility for the discrepancy is that the solutions in this test were at approximately 25°C whereas Palin may have worked at lower temperature.

Over a period of four months, tests were made on a plant effluent carrying chloramine-type residuals with water temperatures ranging from 32.5 to 40.0°F (0.3° to 4°C) using Palin's procedure. Very clear-cut end points were obtained with no apparent fading and the results checked excellently with the total residual chlorine concentrations found amperometrically. In a subsequent two-month period with water temperatures ranging from 70 to 76°F (21 to 24°C) on substantially the same water (same plant, same river), no definite end point in fractions 2 and 3 could be obtained. Fading was particularly pronounced in fraction 3. In fraction 1, which gives the hypochlorous acid content, excellent agreement was found with the amperometric procedure even during this second period of observation.

In this test also, the use of Palin's citric acid type buffer to inhibit fading gave no improvement in the chloramine determination. The pronounced fading which was observed would make it appear that there is some reaction occurring between the liberated iodine and orthotolidine in neutral solution which causes an irreversible loss of oxidizing power. With this in mind, experiments were carried out in which Palin's orthotolidine reagent solution was added to the chlorinated sample and then the sample subjected to amperometric titration. When the residual chlorine consisted only of hypochlorous acid, the addition of the orthotolidine reagent caused the amperometric titration to give a zero reading indicating that the reaction product of the hypochlorous acid and orthotolidine was not reduced by the arsenite reagent used in this titration. When potassium iodide was added and the pH lowered to 4.0 about one-half of the chlorine could be titrated amperometrically.

When all the chlorine was in the form of monochloramine the addition of the orthotolidine reagent caused the amperometric titration to give zero reading unless the pH was lowered to 4.0 and potassium iodide added. Essentially the same result was obtained with dichloramine, in both cases about one-half of the chlorine added being recovered by titration at low pH.

It can be concluded that all of the three forms of available chlorine react irreversibly with orthotolidine in the neutral range. This means that orthotolidine does not really function as an indicator but rather as a mediator. Instead of one single quantitative reaction there are two series of reactions either one of which may predominate. Thus, the Palin method does not strictly make use of Harold's[2] suggestion since it does not depend merely on the different degrees to which the different forms of chlorine liberate iodine.

New Amperometric Procedure

In the course of experiments on continuous automatic recording of residual chlorine it had been observed[8] that solutions that probably contained dichloramine did not quantitatively liberate iodine until the pH was brought to a quite low value. This led to a series of experiments to determine whether the original observations of Harold's[2] could not be used as the basis of an amperometric titration method.

Marks and Glass[7] have formerly shown that hypochlorous acid quantitatively reacted with arsenite while chloramine cannot be titrated with this reagent unless iodide is present. Subsequently Chamberlin and Glass[10] used this amperometric method as a basis for developing a new set of orthotolidine standards. The accuracy and reliability of the method for solutions containing only hypochlorous acid was thus firmly established.

While it was also definitely established that the chloramines were not titrated with arsenite and that they could be titrated with that reagent after potassium iodide addition, there were some small discrepancies in the results as Palin[1] has pointed out. It now seems that traces of dichloramine were present which caused such discrepancies. Experiments with dichloramine itself confirmed that this indeed was the case. Dichloramine does not liberate iodine from certain concentrations of iodide or react with arsenite in the neutral pH range but does quantitatively liberate iodine at pH 4.

Since monochloramine quantitatively liberates iodine at pH 7, this forms the basis for an amperometric method which will accurately determine all three forms of residual chlorine. Briefly, this method is to titrate free chlorine with arsenite at neutral pH in the absence of iodide, then potassium iodide is added in limited amount and the monochloramine is titrated still at the neutral pH. Finally, the pH is lowered to 4.0, more potassium iodide added, and then the dichloramine titrated.

If sodium arsenite itself is used for the titration, it is necessary in the final step to raise the pH to neutrality again before titrating since sodium arsenite does not react quantitatively with iodine below about pH 6. Fortunately Marks et al.[11] have already shown that phenylarseneoxide solution acts like arsenite towards hypochlorous acid and chloramine and in addition can be used to titrate iodine at low pH. This reagent is used in this way to avoid the additional step of raising the pH at the end.

Solutions

(1) Potassium iodide, analyzed reagent, 50 grams per liter.

*In a recent private communication, Palin has suggested still another modification. The solution of hexametaphosphate is made up to contain a high concentration of a phosphate buffer. Apparently the end point is extremely critical to slight variations in pH and the modification is for the purpose of minimizing such errors.

(2) pH 7 Buffer—35.4 grams monopotassium phosphate, C.P. and 86 grams disodium phosphate, C.P. ($Na_2HPO_4 \cdot 12\ H_2O$) are dissolved in distilled water and diluted to 1 liter.

(3) pH 4 Buffer—480 grams glacial acetic acid and 243 grams sodium acetate trihydrate are dissolved in distilled water and diluted to 1 liter.

(4) P.A.O. Solution—Standard phenylarseneoxide solution*—approximately 0.8 gram of phenylarseneoxide powder is dissolved in 150 ml. of 0.3 N-NaOH. After settling, 110 ml. of this solution is poured off into 800 ml. of distilled water and thoroughly mixed. The solution is brought to pH 6 to 7 with dilute hydrochloric acid solution and finally diluted to 1 liter. It is titrated with freshly standardized iodine solution using starch indicator and finally adjusted with distilled water to .00564 N. One ml. of this solution is equivalent to 0.2 mg. available chlorine[11].

Procedure

A 200 ml. sample of water is treated with 1 ml. of the pH 7 buffer if its pH value lies outside the range 6.0 to 7.5. In an amperometric titration apparatus,[7, 12, 13] the sample is titrated to an end point with standard phenylarseneoxide solution to give fraction 1. Then to the same sample is added 0.2 ml. of the potassium iodide solution and the titration with phenylarseneoxide carried again to an end point to give fraction 2. Finally, 1 ml. of pH 4 buffer and 1 ml. of potassium iodide solution are added and the titration carried to a third end point to give fraction 3. In the absence of nitrogen trichloride the number of ml. of P.A.O. solution in fraction 1 gives HOCl in ppm. available chlorine, that in fraction 2 gives monochloramine in ppm. available chlorine, and that in fraction 3 gives dichloramine in ppm. available chlorine.

In the above, it is assumed that the reader is familiar with the operation of amperometric titrators, however, a word of warning. When an amperometric titrator is used for titrating solutions containing only free chlorine only normal rinsing of the cell and sample jar is required following a determination. However, in determining dichloramine a fairly high concentration of potassium iodide is used and therefore particular care must be exercised in rinsing cell and sample jar. Particularly, some of the potassium iodide can diffuse into the cotton wick between the platinum coil and then later come out of the wick in a true chloramine solution to which no KI had been added, giving the false assumption that free chlorine is present.

*Currently available only from Wallace & Tiernan, Inc., Newark, N.J. The solution may also be made by the user. Laboratory supply houses wishing to make and supply the solution may obtain the formula from Wallace & Tiernan, Inc.

Supporting Data[6]

Samples of water containing only monochloramine were made up in the manner previously described in connection with the Palin method. These solutions were then analyzed by the procedure given above. Illustrative data are shown in Table 1 wherein it is seen that at pH 7, monochloramine gives no titration in the absence of iodide but that it is quantitatively determined at this pH when 50 ppm. potassium iodide is present. It will be noted that there is usually a slight additional increment of titration obtained in the third fraction. This is undoubtedly due to small amounts of dichloramine which are unavoidable. Considering this fact and the fact that it is impossible to avoid the loss of a slight amount of chlorine in the process of dilution, the agreement between calculated and observed values is considered satisfactory. Experiments have also been carried out with monochloramine using potassium iodide in concentrations from a fraction of a part per million to 250 ppm. Below 25 ppm. the titration begins to fall off while above 50 ppm. further amounts cause no change. Even a trace of potassium iodide, however, gives some titration so that in the determination (and detection) of free chlorine, iodide must be rigidly excluded—hence the note above on careful rinsing of cell and jar.

Table 1
Amperometric Titration of Preformed Monochloramine
25°C
ppm. Available Chlorine

Calc. from Dilution	Fraction 1	Observed Fraction 2	Fraction 3
0.69	0	0.68	0.01
0.67	0	0.68	0.01
1.28	0	1.25	----
0.92	0	0.89	0.03
0.97	0	0.95	0.00
1.93	0	1.86	0.01

Further experiments have also been carried out with no iodide present and with 50 ppm. iodide over the pH range 4 to 8. As the pH goes above 7.5, the titration gives slightly lower values with this iodide concentration. On the other hand, as the pH goes below 6, the monochloramine begins to titrate in the absence of iodide. At pH 4 practically all of it is obtained. Titrations have been carried out at 1°C using the recommended procedure and the results checked those obtained at room temperature.

Solutions containing only dichloramine as previously described were also analyzed by this amperometric procedure. Illustrative data are given in Table 2 which shows that none of the dichloramine is titrated at pH 7 either with no KI or with 50 ppm. KI. At pH 4 and excess KI, the dichloramine is quantitatively determined. In a minority of cases there was a slight titration at pH 7 which showed the presence of traces of either hypochlorous acid or monochloramine or both. In view of the difficulty of avoiding traces of these materials and of the inevitable loss of some available chlorine on dilution, the agreement is considered to be very satisfactory. It will be recalled that dichloramine undergoes a decomposition reaction when the pH is raised to 7.

Table 2
Amperometric Titration of Preformed Dichloramine
25°C
ppm. Available Chlorine

Calc. from Dilution	Fraction 1	Observed Fraction 2	Fraction 3
0.46	0	0	0.45
0.71	0	0	0.71
0.73	0	0.04	0.68
0.78	0	0	0.80
0.84	0	0	0.84
1.81	.02	.07	1.67

When the titration is carried out at pH 7 with quantities of KI much greater than 50 ppm. there is some liberation of iodine from dichloramine. Thus, as much as 250 ppm. KI causes liberation of about 10 per cent of the available chlorine. On the other hand, even at pH 4, 50 ppm. KI is not sufficient to give immediate liberation of iodine; 250 to 500 ppm. is the minimum necessary. Using this amount of KI the reaction proceeds quantitatively at pH values even silghtly higher than 4.

On the other hand, as the pH goes above 4.5, the reaction becomes too slow and a quantitative titration procedure cannot be carried out in a reasonable time. Decreasing the pH to a value below 4 does not change the effect of dichloramine on potassium iodide. Below pH 3.5 oxidized manganese begins to titrate so the limits are pH 3.5 to 4.5. Titrations of dichloramine by the above procedure at temperatures as low as 3°C were carried out with the same result as at room temperature.

Table 3
Amperometric Titration of Preformed Mixtures of HOCl, NH_2Cl and $NHCl_2$ ppm. Available Chlorine

Fraction 1 Calc.	Obs.	Fraction 2 Calc.	Obs.	Fraction 3 Calc.	Obs.	Total Calc.	Obs.
0	.02	0.89	0.97	0.80	0.68	1.69	1.65
0	.03	0.80	0.92	0.76	0.65	1.68	1.60
0.43	0.30	0.90	1.04	0.76	0.68	2.09	2.02
0.02	0.04	0.68	0.68	0.43	0.28	1.12	1.00

Further experiments to check this method were performed with a mixture containing hypochlorous acid, monochloramine, and dichloramine in various proportions. Some of these results are given in Table 3. In these experiments solutions of the single substances were made up and stored separately. At the time of the experiment the proper quantity of each was pipetted into 200 ml. of demand-free water and then the analytical procedure begun immediately.

Even though the three compounds were kept separate until the last moment it was impossible to avoid some reaction which caused changes in the proportions of the various forms. Thus the chloramine solutions had to contain some excess ammonia for stability and this always reacted with the hypochlorous acid to give low values for this substance and usually high values for monochloramine. Also, there was a loss of dichloramine through decomposition when it was added to a solution of pH 7 and through conversion to monochloramine by a reaction with the excess ammonia at this pH. Considering these complications, the agreement between calculated and observed values is believed to be sufficient to lead to the conclusion that the method is quantitative.

Nitrogen Trichloride

Application of this method to solutions containing only nitrogen trichloride shows that about two-thirds of the chlorine from this substance is obtained in the first increment and, therefore, registers as free chlorine. A slight additional amount is obtained in the second step and registers as monochloramine. Practically all the remainder is found in the third step and is counted as dichloramine. Thus, for all practical purposes, nitrogen trichloride acts like two-thirds hypochlorous acid and one-third dichloramine.

The total concentration found by this method checks the total as determined by the starch iodide method. On the other hand, it will be recalled that Dowell and Bray[14] many years ago showed that nitrogen trichloride is not quantitatively determined by starch iodide tiration. About 20 percent of the chlorine is lost during this titration and it is customary to apply a correction factor when determining nitrogen trichloride.

Following Palin's procedure, solutions were extracted with carbon tetrachloride to remove nitrogen trichloride and then amperometric titrations were performed on the residue. The errors involved were found to be quite large and the extraction procedure is cumbersome.

On the finished water at the Brantford plant, high in mineral matter and containing some unreacted organic matter some of the CCl_4 enters the water layer as an emulsion which does not separate. This made the end point difficult to observe particularly in causing a blue coloration to persist leading to overtitration.

At Brantford where NCl_3 is always present in the early part of the treatment process and is removed[10] prior to distribution, the NCl_3 does not pose a question of magnitude, but simply, is NCl_3 present or absent? From considerable experience with NCl_3 the author feels that the presence or absence is all that is generally required to be known, that the nose is about the most sensitive instrument for detecting NCl_3 and that estimatiton of NCl_3 is called for only in the highest type of research.

In view of the fact that NCl_3 is usually present in very small amounts, although pungently obvious to the nose, it is not believed to be worthwhile to go through the extraction method for ordinary purposes. The amounts are usually so small as not to greatly influence the other readings.

One way of conveniently arriving at a reasonable value for the NCl_3 content is as follows:

With least possible agitation place the required quantity of sample in the titrating jar, place jar on titrator and before any stirring takes place, rapidly add in succession the pH 4 buffer and the KI. Commence stirring and titrate immediately. In this way little volatile NCl_3 is lost and the total titration is due to free chlorine, monochloramine, dichloramine and nitrogen trichloride.

A second portion of the original sample is then proceeded with but prior to any buffer additions or titrations, stirring in the titrator is permitted for 2 minutes. NCl_3 is readily aerated out in this manner following which the normal titrations may be performed for free chlorine, monochloramine and dichloramine. The difference between the totals obtained on the two samples will be NCl_3 after applying the suitable factor.

(In the next issue of *Water & Sewage Works*, the author will conclude this highly important article on the determination of chlorine residuals in water. The next installment will deal with plant operations, and chlorine residuals in distribution systems.—The Editor)

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Romano Joins Staff of Gannett Firm

Gannett, Fleming, Corddry & Carpenter, Inc., Harrisburg, Pa., has announced the appointment of Mr. James Romano to the engineering staff of the Water Works Division.

Mr. Romano is a graduate of West Virginia University; served as an officer in the Corps of Engineers in U.S. and European Theatre for 5 years; and has been with the U.S. Engineer Corps for 12 years on river and flood control work.

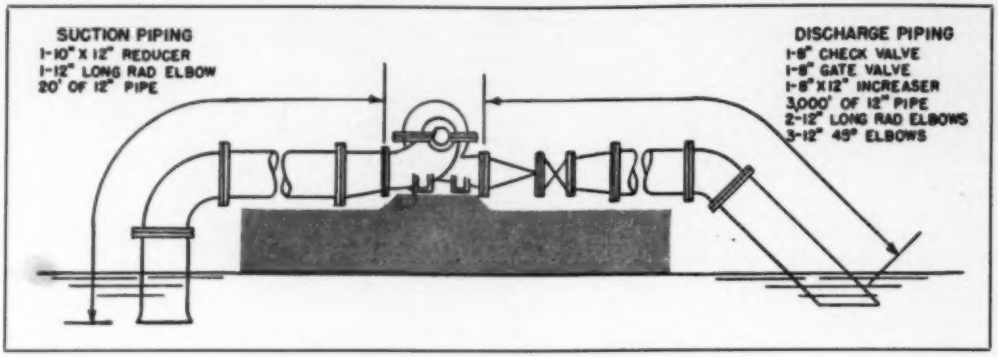

Fig. 28—Simple pumpage system in which head is entirely friction.

Basic Factors In Centrifugal Pump Application*

Part 5—Determining Pumping System Needs

by ROY CARTER *and* IGOR J. KARASSIK, *Application Engineers, Worthington Pump and Machinery Corp., Harrison, N.J.*

TO obtain the desired results a centrifugal pump must have a characteristic suitable for operation in the system on which it is to be used. It is therefore necessary to first consider the characteristics of the system, and the definite needs, if a suitable pump is to be obtained. Usually it is a simple matter to determine the system characteristics; but, occasionally a complicated system is encountered requiring analysis of parts of the system and then combining these to show the system as a whole.

As discussed in Part 2, published in February 1951, the total operating head for a given capacity through a system is the algebraic sum of the static head from supply level to discharge level (H_{st}); the terminal pressure minus the suction pressure ($P_d - P_s$); all friction losses at this capacity (h_f); and the entrance and exit losses (h_i and h_e), all expressed in feet of the liquid being handled. The various elements and nomenclature are shown in Figure 29.

While the simplest system would be one with only static head, such a system could not be more than approached in practice because, in any actual system, there would be some friction losses. Should there be no static head component nor any difference in pressure on the suction and discharge liquid levels, as in Figure 28, the head would be entirely frictional.

Determining Friction Head

In determining allowance for friction heads in a system, it must always be remembered that the loss in the piping depends upon the roughness of the walls and this generally increases as the pipe ages. Thus, if the loss is calculated on the basis of new pipe and a pump is selected for the total head thus determined, it will not deliver its rated capacity through the system a few years later when the roughness has increased and the friction loss has increased.

It has become customary in estimating pipe friction, where extreme detailed study is not warranted, to use friction head values that would be expected when the pipe is 15 years old. Thus, most tables on pipe friction are based on Williams and Hazen values of C = 100. Practice in figuring allowance for losses in fitting varies. Some use "equivalent length of piping" while others use a percentage of the velocity head. Both methods require some exercise of judgment in relating specific fittings to known values. Recent publication of data by the Hydraulic Institute has been helpful to those using the $K \times V^2/2g$ method.

Using frictional values for C = 100 for the pipe and figuring the losses in fittings and valves on the K times velocity head basis, the head for the system shown in Figure 28 for a flow of 2000 GPM would be determined as illustrated in accompanying example.

EXAMPLE OF ESTIMATING FRICTION HEAD

Entrance loss—12" bell not well rounded—K = 0.5	0.25 ft.
12" long radius elbow—K = 0.2	0.10
20' of 12" pipe @ 1.49'/100' pipe	0.30
10" x 12" reducer—allow	0.10
8" gate valve—K = 0.2	0.51
8" swing check valve—allow K = 1.8	4.56
8" x 12" increaser—allow K = 0.30	.76
3000 feet of 12" pipe at 1.49'/100' pipe	44.70
2—12" long radius elbows K = 0.2	0.20
3—45° elbows K = 0.2	0.30
Exit loss—12" pipe—1 velocity head	0.50
Total losses	52.28 ft.

(Round off to—52.3 ft.)

Of this 52.3 feet head, 45 feet is loss in the pipe and will vary according to the C value of the pipe. The remaining 7.3 feet is allowance for loss in valves and fittings and will vary only slightly with the age of the pipe.

Figuring the values for various other capacities, we would be able to plot the relation of the system head vs. capacity as shown on Figure 30 (identified by the notation of C = 100).

Without further analysis it would have appeared that, had a flow of 2000 GPM been wanted, a good selection would be the pump with characteristic also shown on the same figure—Figure 30. Had the pipe been

*The fifth article of a series dealing with basic considerations in the selection, application and operation of centrifugal pumps. For earlier installments see the January, February, May and August 1951 issues of this magazine.

new, the friction loss in the pipe would have been less. If the condition of the pipe was such that a C = 130 might be expected, the pipe friction losses would be but 61.5% of those resulting with C = 100. For example, at 2000 GPM it would have been 45×0.615 or 27.7 feet, thus giving a total friction head, including that of the fittings, of $27.7 + 7.3$ or 35.0 ft. The resulting system head curve is shown on Figure 30, labeled C = 130. As will be noted, this would have resulted in more capacity being delivered by the pump with more power and a lower efficiency, namely, 2320 GPM, 46 feet total head and 82.5% efficiency.

If this installation was for a project where it was known that the water caused a slow increase in friction with increasing age of pipe, for example reaching a C value of 110 in 15 years or longer; or, if power costs were very high so that it was intended to keep the friction low by periodic cleaning of the pipe, then it would be advisable to select the pump for a lower head. Using the system head for C = 110 as the maximum to be encountered and at which 2000 GPM capacity is desired, the pump would have to be selected for 45′ total head. The same pump, if used with a smaller impeller for 2000 GPM, 45′ head would result in an initial efficiency of 82.5% for the system when the piping had a C of 130, and reaching about 84.5% when the C value had fallen to 110. If it were desired to obtain a better economy over the operating range, a larger pump would have to be used. The larger pump would have had a 10″ discharge, and a 10″ gate and a 10″ check valve would logically be used with smaller friction losses, so we would have to refigure the system getting the values shown in Figure 31.

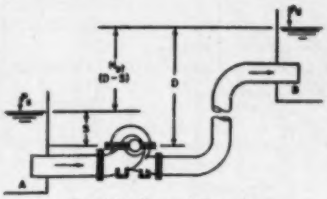

Fig. 29. General Formulas

Suction Head

$$h_s = S - h_{fs} - h_i + P_s$$

Discharge Head

$$h_d = D + h_{fd} + h_e + P_d$$

Total Head

$$H = h_d - h_s = H_{st} + h_f + h_i + h_e + (P_d - P_s)$$

Net Positive Suction Head

$$NPSH = S - h_{fs} - h_i + P_s - P_{vp}$$

Nomenclature of Heads Not Shown on Diagrams

h_{fs} = friction head loss in suction line

h_{fd} = friction head loss in discharge line

h_f = total friction head loss from A to B

*h_i = entrance loss at A

*h_e = exit loss at B

P_{vp} = vapor press. liquid at pumping temp.

*Some engineers include these losses in h_{fs} and h_{fd}.

All heads and pressures must be expressed in feet of liquid with proper algebraic signs. Pressures P_s, P_d and P_{vp} can be either in gage or absolute values but, in any case, must all be measured above the same datum.

To convert pressures in psi (pounds/sq. in.) to feet of liquid, multiply by 2.31 and divide by specific gravity of the liquid at pumping temperature.

Results With Two Pumps in Parallel

One of the most common pumping systems in which the head is all or nearly all friction is encountered in circulating pumps for surface condensers. These are generally complicated by the need of less water in winter when the water temperature is low than in summer when the water temperature is high. Generally, two pumps of equal capacity are used. Both are run to give the required capacity for summer operation and one is run alone in winter. In such an installation the head would be made up of losses through some piping and fittings carrying the capacity handled by one pump and losses through other piping, fittings, and the condenser which would be carrying the combined flow. Thus *the system head curve occurring with one pump running will not be the same as with two pumps running.* The losses for the individual pumps are shown by curve P_1 on Figure 32. Naturally with 2 pumps running, twice the capacity flow through the condenser gives the same loss in the individual piping for each pump. This is shown by curve P_2. The loss in the condenser and in the piping and fittings in which the flow is the same as through the condenser is marked C. At any capacity the system head with one pump running is therefore the head shown on curve P_1 plus that shown in curve C. With two pumps running it is the head shown on curve P_2 plus that shown in curve C. If the loss in the individual piping (P_1 & P_2) is low, the resulting curves S_1 and S_2 are so close that only S_2 can be constructed and the discrepancy ignored.

In such a pumping problem it is desired that good efficiency be obtained both when two pumps are running and when one pump is running. Plotting curve S_2 against the capacity handled by each pump, we obtain the system curves shown on Figures 33

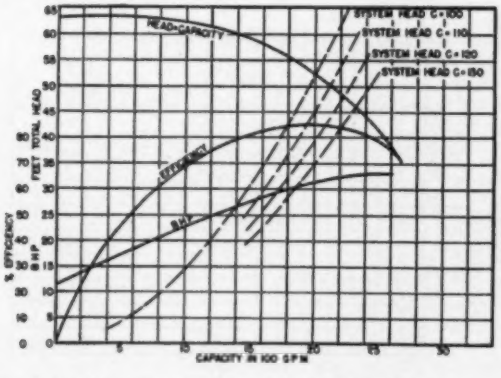

Fig. 30—System Head for fig. 29 installation with 8″ pump.

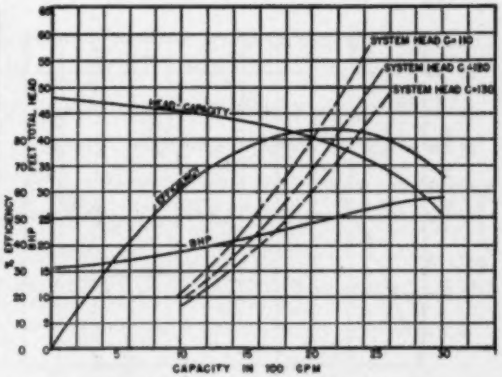

Fig. 31—System Head for fig. 29 installation with 10″ pump.

(Results obtainable with various roughness factors and comparison of results obtainable with an 8″ pump vs. the larger 10″ pump and improved performance thereby.)

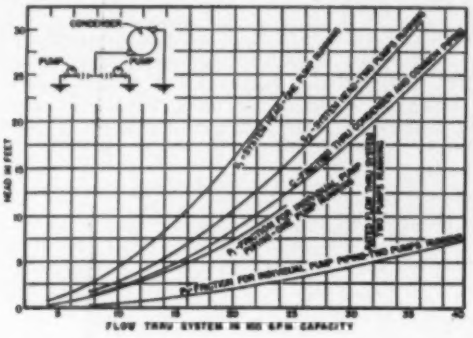

Fig. 32—Analysis of typical condenser installation with two pumps in parallel. Operating conditions shown for single and two pump operation.

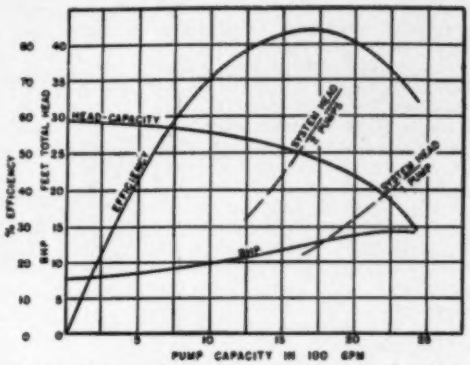

Fig. 33—Ideal pump selection for the fig. 32 system of parallel pumps if both single and dual pump operation are equally important.

and 34. The problem for this installation is to select a pump to give good efficiency both at 1600 GPM 25 ft. TDH and at the capacity and head resulting at the intersection of the pump head-capacity curve and the system curve S_1. This generally requires the use of a larger pump than if the pump were selected merely for the 1600 GPM 25 ft. TDH condition. Figure 33 shows an ideal selection for such a problem with 82% pump efficiency obtained for both operating conditions. Figure 34 shows the results that would be obtained had a smaller pump size selected merely for the two pump operation been used. Although, in this case, the smaller pump has a flatter head capacity curve and more actual capacity would have been obtained with one pump operating, only 74.5% pump efficiency would have been obtained for this condition. Had this installation been one in which both pumps are normally operated all the time and two units had been installed instead of one larger unit in order to permit operation at reduced capacity if one unit is out of service for some reason, the selection shown in Figure 34 would have been preferable to that on Figure 33 as the efficiency at 1600 GPM 25 ft. TDH is better and the first cost would be lower.

It is to be noted that the system illustrated in Figure 32 indicates no static head, and is based on the assumption that the full syphon head is recovered. While syphons up to 25 ft. or higher are feasible, full recovery is rarely obtained. It should also be noted in discussing the system illustrated in Figure 32, that unless the piping and condenser water ways are primed before the pumps are started, the pumps will have to fill the piping and condenser before the syphon can be established. Thus, in the starting cycle, a static head equal to the syphon leg will be encountered just before the syphon is established, so the maximum starting head could be determined by adding the syphon leg as a static component to curves S and S_2. To obtain a pump characteristic which will deliver sufficient capacity to establish the syphon without compromising the results to be obtained when the syphon has been established, is often impossible. Modern practice is to provide priming equipment, so the syphon loop can be evacuated, and the syphon established without making it necessary for the pump to overcome a high starting head.

When there is a static head, or its equivalent in pressure or both, included in the head the system head is the sum of these components and the friction head. Thus, for the system as shown in Figure 35, the friction head losses would have been determined in curve form as shown on that figure and added to the static head, giving the system head indicated. Had the pipe been new with a coefficient of C = 130, very little increase in capacity would have resulted, as can be seen from the figure. Thus, the possible error in determining the friction

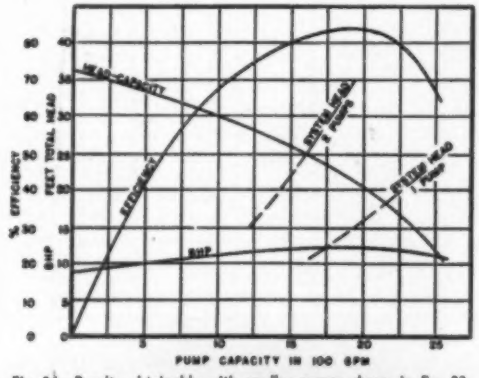

Fig. 34—Results obtainable with smaller pumps shown in fig. 33. Shows poor efficiency resulting during single pump operation.

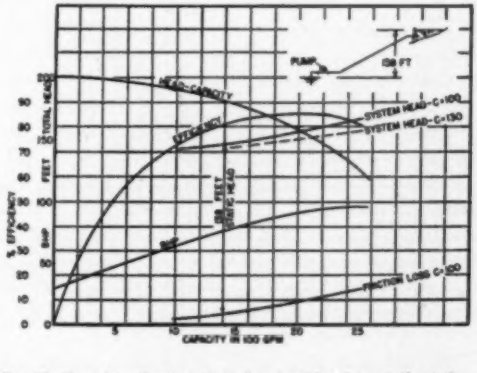

Fig. 35—Revealing the fact that when total head is mostly static error in computing friction losses or changes in friction has little effect.

loss becomes less important as the percentage of the friction head in the total becomes less.

Effects of Variable Static Head

At constant speed, the head developed by a centrifugal pump varies with the capacity delivered by the pump. Thus, if it is used on a system in which there is a variation in static head, a variation in the capacity delivered through the system will result. Frequently, when buying a pump for such an installation, a purchaser will calculate the friction at rated capacity, add it to the average static head and state that as the design head. In addition he will add the same friction head to the maximum and minimum static heads and give the resulting heads as the maximum and minimum operating heads that the pump will encounter in service. This practice neglects the change in friction with change in capacity and unnecessarily handicaps the manufacturer in selecting a suitable pump for the service. For example, in the installation shown in Figure 36 some purchasers would specify that the pump had to operate over a head range of 65 to 95 feet giving rated capacity of 250 GPM at 80 feet head. Thus the pump whose characteristic is shown on Figure 36 would have seemed to be unsatisfactory, while actually it will deliver 79% rated capacity at the maximum static head and 115% rated capacity at the minimum static head.

It is often advantageous to know what capacity will be delivered by a pump operating on a system as shown in Figure 36 in terms of static head. Naturally for any capacity this will be the total head on the pump minus the friction loss at that capacity. This can be plotted as shown by the dotted curve in Figure 36 and shows, for example, that the flow to the tank will be 244 GPM when the static head is 57 feet.

[The next article of this series will deal with "Determination of Pump Delivery on Its System."—Ed.]

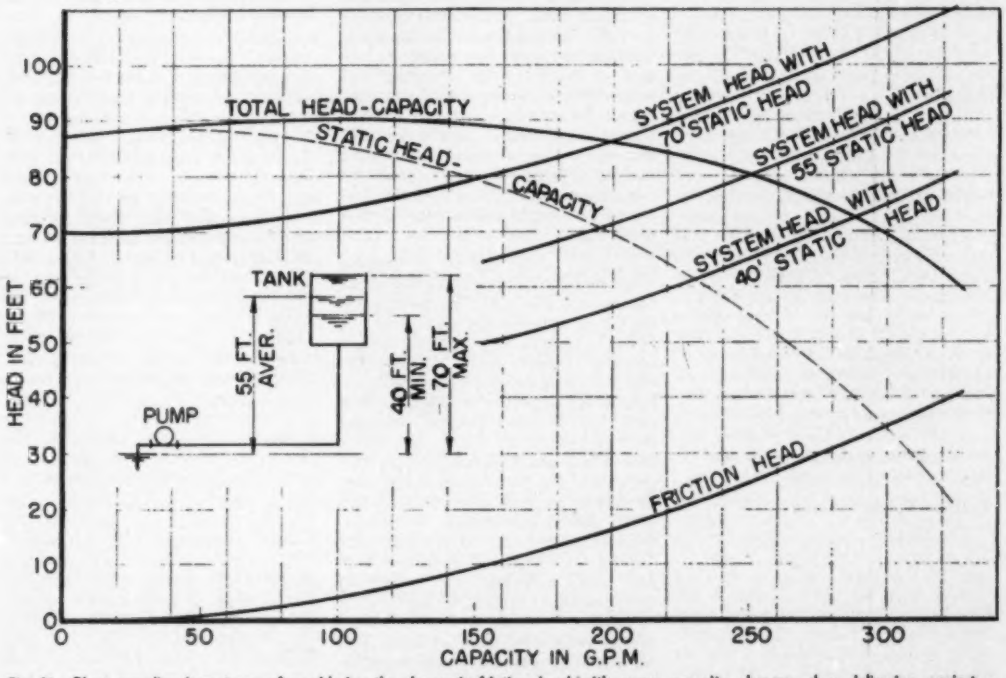

Fig. 36—Chart revealing importance of considering the change in friction head with pump capacity changes when delivering against a variable static head.

(Note that actual operating head may cover quite a range, with important efficiency changes resulting.)

SOCIAL SECURITY FOR MUNICIPAL EMPLOYEES

We do not have a record of how many states have entered into an agreement with the Federal Security Agency but under the revised Social Security Act if an agreement is entered into between the state and F.S.A., Social Security is available to municipal employees within that state provided the municipality agrees to pay its share of the Social Security Tax just as industrial enterprise does.

In any such agreement, approval of the respective State Tax Commission must also be had. Nebraska is one of the states to recently enter into the required agreement with F.S.A., which makes Social Security benefits available to state and municipal employees. Pennsylvania now has a bill in the legislature which, if passed, will make Social Security available to municipal employees. The Pa. Sewage and Ind. Works Assn. recently appointed a special legislative committee to work in the interest of getting this bill through the legislature.

False Economy

Buying an article because it is cheap, just to save money, is like stopping the clock to save time.

Computing Size of a Revenue Bond Issue

For the Commonfields of Cahokia Water District

by GEO. D. RUSSELL, *Designing Engr., Russell & Axton Engrs., St. Louis, Mo.*

THE Commonfields of Cahokia Public Water District is the name given to the Water District located just south of East St. Louis in Illinois. The District includes the village of Pearl Harbor and the area adjacent to it. The Water District extends from Pearl Harbor to the city limits of the City of Dupo. Portions of the water lines owned by the City of Dupo extend into the Cahokia Water District. The District was organized early in 1950 in order to give better service to homes in the Cahokia area which are connected to the water lines of the City of Dupo and the Village of Pearl Harbor, and to supply water to a group of potential water consumers who had no access to a public water supply. It was necessary for the Cahokia Water District to issue bonds to provide funds to enable the District to purchase and renovate the water lines in the District area, owned by the City of Dupo and the Village of Pearl Harbor, and supply water to homes not located on existing water lines.

Revenue Bonds Favored

The District commissioners decided that revenue bonds would be acceptable to the bond houses and more popular with the home owners in the District than any other type of bond which might be issued. The popularity of revenue bonds is due to the fact that this type of bond places no tax obligation on the property.

The study discussed in this paper was made to determine the amount of bonds which could be financed from the revenue to be expected from the water services provided by the District. The computations of the amount of the justifiable bond issue was complicated by the fact that only a portion of the water lines owned by the City of Dupo were to be purchased.

In November, 1950, there were 544 customers connected to the water lines that were to be purchased from the City of Dupo and 595 customers connected to the water lines that were to be purchased from the Village of Pearl Harbor. This totals 1139 customers who will assuredly be connected to the water lines of the Cahokia Water District as soon as it can begin operation. Also in the District, there are 103 homes adjacent to the water lines of the City of Dupo and the Village of Pearl Harbor which are not now utilizing these public water supplies. There were 851 homes not served by any water lines in November, 1950. In addition to the above mentioned potential users there are 13 commercial establishments in the District which might connect to the new water lines.

The 851 homes and 13 commercial establishments represent all the possible services which will be provided by the construction of the new lines. The Cahokia District, however, has several housing projects under construction and the prospects for growth are encouraging, especially with the impetus provided by the present national emergency with its consequent influx of workers into industrial areas. Records show that most of the water consumers in the area now use less than 2,000 gallons per month. However, there is ground suitable for industrial development available in this District and many industries are located in crowded areas nearby. Therefore, it is probable that there will be industrial growth in this District soon. The industrial growth will result in an increased demand for water, with a consequent increase in revenue to the Cahokia Water District.

It is usually necessary in a new water district to estimate the earnings on an assumed basis because of the fact that no financial data for the area under study is available. However, in the study made for the Cahokia Water District it was not necessary to assume a revenue because the water records of the City of Dupo and the Village of Pearl Harbor showed the water consumed by and the revenue from a large percentage of the consumers in the Cahokia Water District. In order to determine how many householders in the Cahokia Water District desired water from the new District, the Illmo Survey Company was engaged to make a house to house canvas and determine whether the potential water users would take water from the new District when service was made available to them. The canvas confirmed the earlier convictions that the existing water service was poor. In the canvas made by the Illmo Survey Company, approximately 2,000 home owners were contacted and only two of them did not seem to want water from the new water district. This survey not only showed a need for water, but indicated that revenue would be forthcoming as soon as services were made available to the people.

Financial Study

In order to determine both an equitable price for the City of Dupo's waterworks holdings in the Cahokia District and the revenue which could be expected from each of the consumers, a study was made of the City of Dupo's water records during the previous two years. The records were analyzed also to give an idea of operating costs and other pertinent data which would indicate both the amount of profit to be expected from the new venture and the worth of the City of Dupo's waterworks holdings in the Cahokia District from an investment standpoint. The data for the period from October, 1949, to September, 1950, are summarized in Table 1.

Table 1

CONSUMPTION AND REVENUE FOR THE CITY OF DUPO'S HOLDINGS IN THE CAHOKIA WATER DISTRICT

Month	Year	Consumption	Revenue
October	1949	2,425,350 gallons	$ 1,137.37
November	1949	2,496,313 gallons	1,142.53
December	1949	2,450,785 gallons	1,148.14
January	1950	2,450,785 gallons	1,070.87
February	1950	2,266,808 gallons	1,083.37
March	1950	2,562,688 gallons	1,177.42
April	1950	2,278,078 gallons	1,097.13
May	1950	2,295,263 gallons	1,229.44
June	1950	2,656,093 gallons	1,226.89
July	1950	2,433,298 gallons	1,161.06
August	1950	2,722,870 gallons	1,283.56
September	1950	2,388,753 gallons	1,173.98
Total for the year		29,137,952 gallons	$13,931.76

From the City of Dupo's data, it was found that approximately 40 percent of the total metered installations served by the City of Dupo were in the Cahokia Water District. It was also found from the data analyzed that about 27 percent of the water purchased by the City of Dupo was used in the Cahokia Water District. The difference between the metered installations (40 percent) and the percentage of water used (27 percent) is due to the fact that the City of Dupo sells water to several large users. The City of Dupo purchases its water from the East St. Louis Water Com-

pany at an average annual cost of about $12,000. Since 27 percent of the water was used in the Cahokia Water District, it seems reasonable that 0.27 times the average annual bill should be charged to purchasing water for the City of Dupo's customers of the Cahokia Water District. Therefore, the purchase price of water for the Cahokia District during 1950 was $0.27 \times \$12{,}000 = \$3{,}240$. The operating cost for the City of Dupo was approximately $13,000 from October 1, 1949, to September 31, 1950. The operating costs for the City of Dupo's system are based on the cost of repairs to the system, supplies, and salaries, and these costs are not too greatly affected by the size of meters and pipe lines or the quantity of water consumed. It is probable that the operating costs are proportional to the number of metered connections rather than to any function of the quantity of water used. Therefore, it was assumed that 40 percent of the total operating costs would be chargeable to the Cahokia District. This gave an estimated operating cost for the Cahokia District of $0.40 \times \$13{,}000 = \$5{,}200$. The total of the two figures which were computed above ($5,200 and $3,240) show the cost at present for operation and supplying water to the Cahokia District to be $8,440.

Depreciation of the water lines is an expense which must be considered. A study was made to determine present replacement value, age and depreciation rate for each of the component parts of the distribution system in the Cahokia District. This study resulted in an estimate of the present annual depreciation as approximately $3,000. The total annual expense to the City of Dupo for the water lines in the Cahokia District is, therefore, $8,440 plus $3,000, or $11,440. The annual profit which accrues to the City of Dupo for their Cahokia District holdings is $13,931.76 less $11,440, or $2,491.76. From the standpoint of investment at an interest rate of 3.75%, which is the rate the Cahokia District will have to pay for their bonds, the profit of $2,491.76 will support an investment of $2,491.76 divided by 0.0375, or $66,500. In other words this is the maximum that the Cahokia Water District could afford to pay for the City of Dupo's holdings in the Cahokia Water District.

In order to determine the number of consumers to be expected, it was assumed that the water lines of both the City of Dupo and the Village of Pearl Harbor would be purchased. This would give 1,139 connections in the first year. Even though the survey made by the Illmo Survey Company showed that 862 of the 864 home owners without water available at present would take water, only 75 percent of these connections were considered in the first year in the financial study because there will probably be a time lag of several years before some of the water connections are made. Seventy-five percent seemed to be a conservative figure and may even give a factor of safety to the financial study. Therefore, it was assumed that only 650 new connections would be made during the first year. This 650 plus the 1,139 connections already existing would give a total of 1,789 connections during the second year. After the first two years, it was assumed that the consumers would increase 5% annually. The new connections will be made up from the remainder of the 864 potential consumers and the probably new consumers which a ten year study of the area indicated would connect to the new water lines. The estimate of 5% annual increase seems conservative when consideration is given to the fact that the District is contiguous to the heavily industrialized East St. Louis area. This area will undoubtedly grow and extend into the Cahokia District because there is land suitable for both industrial development and homes available in the Cahokia Distrist and suitable land is becoming scarce in the East St. Louis area.

A study of comparative costs in the City of Dupo's water system and the Pearl Harbor water system was made. After this study had been made, it was concluded that an annual operation cost of $22,200 would be reasonable for the Cahokia Water District. This figure includes the cost of water purchased from the East St. Louis Water Co., all salaries for the water district, supplies, office rent, truck operation, maintenance and repairs for the distribution system, overhead and insurance and miscellaneous costs.

The estimated operation costs were increased to $24,400 in the second year, due to the large increase in the probable number of connections upon completion of the construction. After this second year the estimated operation cost was increased about 1% per year due to the cost of water for additional services and the additional maintenance necessary after the new connections are made to the lines.

Determining Adequate Water Rates

After a study of the prevailing rate structures and the probable amount of revenue required, it was decided that the water rates already being used by the Village of Pearl Harbor were equitable and would produce sufficient revenue. There was also a psychological advantage in the use of these rates as about one-third to one-half of the people in the District were already paying these rates. The rates adopted are shown in Table 2.

Table 2

PROPOSED WATER RATES FOR THE COMMONFIELD OF CAHOKIA PUBLIC WATER DISTRICT

Gallons Consumed	Cost
0- 2,000	$2.00 minimum
2,001- 2,500	0.76 per 1,000 gallons
2,501- 3,000	0.74 per 1,000 gallons
3,001- 3,500	0.70 per 1,000 gallons
3,501- 4,000	0.60 per 1,000 gallons
4,001-10,000	0.30 per 1,000 gallons
over 10,000	0.25 per 1,000 gallons

This proposed rate structure gives an average annual revenue of $30.50 per connection, based on the consumption figures which were derived from the study of the City of Dupo's records. It is believed reasonable that the average usage in the entire Cahokia District would not vary appreciably from the average usage in the area contiguous to the lines owned by the City of Dupo. The prospective bond buyers informed the writer's firm that a coverage of 1.3 would be sufficient for the Cahokia Water District bond issue. In other words for this bond issue the aggregate amount estimated to be available for principal and interest payments had to be 1.3 times that actually needed for those same payments. Average annual revenue produced by rates given in Table 2 was sufficient to give a coverage of 1.37 on a $700,000 bond issue.

From the study cited above it seemed that a $700,000 bond issue was the allowable limit for the Cahokia Water District. It was then necessary to limit the cost of construction, purchase of lines and all other items such as legal fees and engineering fees to $700,000 while still maintaining the services assumed in the financial study. If this could not have been done, both the design and the financial study would have been revised so that the potential revenue and costs were balanced. Since it was possible to limit the entire cost to $700,000 and still give the services assumed in the financial study no revisions were necessary and the study was submitted to commissioners of the Commonfields of Cahokia Public Water District.

Ouch!

Hubby: "That's a beautiful necklace you're wearing, dear."

Wife: "Yes, isn't it, darling? I found it in the back of your car."

Location of Buried Pipe and Hidden Leaks

by HAROLD BERNARD, *Graduate Student, Sanitary Engineering, University of Illinois, Urbana, Ill.*

WITH cost-indices skyrocketing, the water works operator must find more means of economizing in order to offset increases in the cost of transmitting water. Economy can be realized by eliminating as much of the unaccounted-for water as is feasible. Unaccounted-for water, the difference between the volume of water from the water works and the volume reaching the consumer, includes both under-registration of meters and leakage from pipes. This paper will deal with the second factor, leakage and the detection of leaks and location of buried pipes.

Determining Leakage

One method used to determine the presence of excessive leakage is to check the rate of consumption between the hours of 1 and 5 A.M. With a knowledge of the industrial demands during that time interval and a comparison with the average daily pumpage, an indication of the amount of leakage may be obtained. R. D. McGill[1] stipulates that without industrial usage, the night rate of consumption should be approximately 25-30 per cent of the average daily rate. In the "Water Works Manual" of the American Water Works Assn., it is suggested that an upper limit for allowable leakage be 250 gal. per 24 hr. per in. of pipe diameter per mi. If a community is fully metered, the difference between the metered consumption and the volume pumped from the water works will indicate the presence of excessive leakage. Generally, 15 per cent of unaccounted-for water is considered a reasonable figure for leakage where all the water supply into the system and all services are metered[2].

Leakage Survey

If excessive leakage exists in the distribution system, a survey is made to locate the area in which this condition exists. After dividing the area into sections, the site of the leak may be sought by the following methods:[3]

1. WITH A SOUNDING ROD—In the sounding rod method, a rod is lowered into the ground in search of wet earth which is an indication of leakage. The process is repeated until the leak is located.
2. BY HYDRAULIC GRADE LINE—By obtaining the water pressure at several points along the pipe and drawing the hydraulic grade line for the pressure, the leak is found to lie at the intersection of the grade line with the pipe.
3. BY WATER HAMMER—By suddenly closing a valve in the pipe which is suspected to contain the leak, and recording the period between increases in pressure caused by the water hammer, the distance from the valve to the leak can be determined by substitution in the formula:

$$D = TV/2$$

Where D is the distance from the valve to the break in feet
T equals the time of return of the pressure wave in seconds
V is the velocity of the pressure wave in fps.

4. BY COLORING MATTER—If a dye is placed in the pipe, the site of the leak may be determined by observing the point of emergence of the colored water.
5. BY QUICKLY FILLING A BADLY LEAKING PIPE—When a pipe drains rapidly because of a bad break, the distance to the leak can be obtained by measuring the volume of water necessary to quickly fill the pipe and dividing that figure by the pipe area.
6. BY MECHANICAL AMPLIFICATION OF NOISE FROM A LEAK—Since water escaping from a leak emits a sound, an amplifier can determine the site of the leak by locating the maximum intensity of the sound.

Electronic Pipe Finding

With the exception of locating the point of leakage with a sounding rod, all the methods indicated above, first require finding the pipe containing the leak. In many instances there are no records of the location of the pipe and its discovery must be left to chance or to electronic methods. An instrument which can be used to locate both the pipe and leak is an electronic detector especially designed for this purpose. The apparatus consists of a transmitter which emits electromagnetic waves that are induced in the earth. Any pipe in the field of the waves will act as a path of the return current and will radiate a field envelope[4] that can be received by an appropriate detector, as shown in Fig. 1. If the detector is in a plane perpendicular to the field, the ensuing signal obtained will be at a maximum. This phenomenon is used to locate the pipe.

The transmitter and receiver are separated by at least 30 feet to prevent coupling directly through the air, and the operators advance across the pavement in search of the buried pipe. When there is no metal introduced between the two units, the sound heard on the detector is low and steady. As a metalic object becomes interposed between the two units, the sound suddenly increases to a maxi-

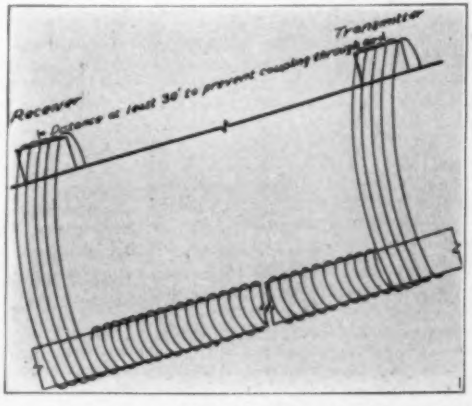

Fig. 1—Sketch showing induced electromagnetic field and field envelope around pipe.

mum. The line between the centers of the two units establishes the direction of the buried pipe. The site of the leak can then be detected.

Leak Detection

As a fluid under pressure escapes through an irregular orifice, such as a break caused by structural failure, vibrations are emitted which travel along the pipe for considerable distances. An instrument tuned to the same frequency as the vibrations can pick them up, and subsequent amplification of the sound will identify the leak.

The pipe-finding apparatus can be modified to detect the leak vibrations by connecting a sensitive microphone to the amplifier as indicated by the manufacturer. The microphone is placed on a pick-up plate which is set on the ground at certain intervals, and the intensity of the resulting sounds compared. At the point of maximum intensity the instrument is directly above the leak.

If the vibrations of the leak cannot be detected as described, another method must be used in which the microphone is placed in contact with the pipe. This method is based on the fact that the intensity of sound is 100 times stronger along a pipe than through the ground. The pick-up plate is placed on those hydrants, valves, and meters which are believed to be in the vicinity of the leak, and the intensity of the sound determined. The leak lies between the two readings which have the greatest intensities.

Should the leak still not be located, contact holes must be drilled and a rod lowered until it comes in contact with the pipe. The microphone is then placed on the rod and the intensity of the sound obtained. The sound is followed in the direction of increased intensity until a maximum is obtained indicating the point of leakage.

Pipe Locating

To locate the center-line of a pipe, two methods may be used, the maximum intensity method as shown in Fig. 2, or the minimum intensity method as illustrated in Fig. 3. The latter insures a greater degree of accuracy than the maximum response method. No signal is heard when the plane of the antenna is exactly parallel to the longitudinal axis of the pipe. When the null signal position of the detector is found, the pipe lies directly below the center-line of the antenna. Use of this method will give the position of the pipe within a space less than the diameter of the pipe.

If it is desired to locate the depth of the pipe below the surface of the ground, the pipe-locating apparatus is again used in the null position, but the loop antenna is held at an angle of 45° with the horizontal. The receiver is moved perpendicularly away from the pipe until the null position is obtained. This arrangement forms an isosceles right triangle with the detector, transmitter and pipe. The depth of the pipe below the surface of the earth will be equal to the distance between the center line of the pipe and the center line of the receiver minus the distance of the center line of the receiver to the surface of the pavement. This method locates the depth of pipe below the surface to within nine inches.

The leak detecting unit should be light in weight, have few controls, and have a microphone and headphone which are responsive to the full range of vibrations of leaks, i.e., 1,000 to 10,000 cycles. The appartus should also include a filter which will exclude all sounds and noises not originating from the leak, and it should have a case that is an effective shield against extraneous electric fields.

Because of the savings that can be realized through a decrease in the number of man-hours consumed in locating buried pipe, and through virtual elimination of conjecture in finding and repairing a leak, electronic apparatus for pipe and leak location definitely should be part of the standard equipment of every water works maintenance department.

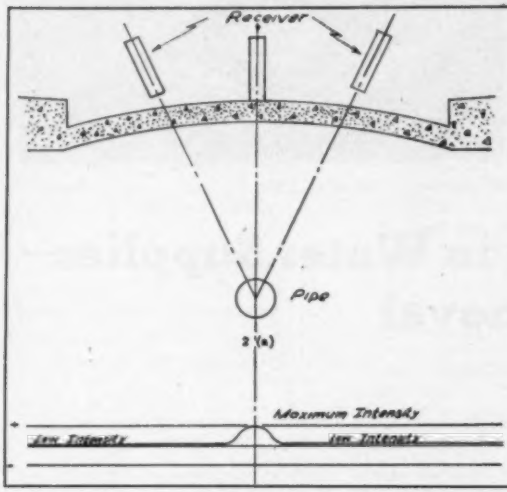

Fig. 2—Loop antenna perpendicular to longitudinal axis of pipe induces maximum current in pipe.

(Characteristics of maximum signal, below.)

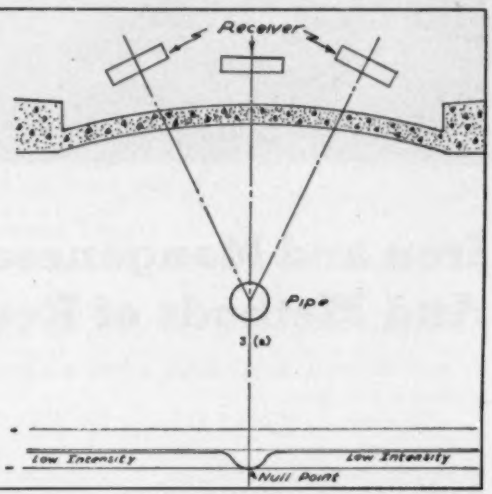

Fig. 3—Loop antenna parallel to longitudinal axis of pipe resuts in null signal.

(Characteristics of null signal, below.)

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Coke Prefilters—Lowell, Mass.—Note Ponded Condition at Right

Iron and Manganese in Water Supplies—And Methods of Removal

by R. H. BABCOCK, *Senior Chemist, Eckenfelder Associates, Inc., Ridgewood, New Jersey.*

[*Lately, Instrumentation Engr. with The Foxboro Co., Foxboro, Mass.*]

THE presence of iron and manganese in domestic and industrial water supplies has long plagued the householder and manufacturer. The domestic consumer is apt to complain about the effects on the family laundry, plumbing fixtures, and the unpleasant metallic flavor that iron imparts to the water. The industrial consumer finds it necessary in many cases to install treatment plants to pretreat his water supply in order to maintain the quality of his product.

The domestic consumer usually objects to the presence of iron and manganese in excess amounts because of the loss of the esthetic value of the water and the chalybeate tastes that are imparted. A glass of water loses its appeal when it resembles weak lemonade and upon standing a red sediment is observed. The ire of a housewife who has just completed the weekly wash and finds the white articles liberally spotted and stained with iron and manganese is well known. Plumbing fixtures that have been stained with iron are virtually impossible for the householder to restore. The effect of a clean bathroom with iron stained porcelain is very distressing to the woman who prides herself on her housekeeping.

Occasionally the presence of excess quantities of these metals will produce distressing gastro-intestinal disturbances, particularly to newcomers to the region. One hospital, located in a city which has a water supply high in iron and manganese (not removed at the treatment plant) recommends that the formulas of new babies leaving the hospital be prepared using bottled spring water.

To a much less degree than other metals, iron and manganese can cause hardness in water. The effect is the same as with calcium or magnesium hardness, namely insoluble metallic soaps are formed until the iron and manganese present are consumed. This is not as important an effect as the others because while the quantities of iron and manganese may be distressing to the consumer, they are not present in the quantities that calcium or magnesium hardness is even in some treated waters.

The distribution systems of those communities which have large quantities of iron and manganese in their finished water tend to suffer from the deposition of various iron compounds and the growth of iron bacteria (Leptothrix, Crenothrix, Gallionella, etc.) within the mains. Both of these can seriously alter the hydraulic characteristics of the distribution system with the possible reduction to dangerous levels of the available pressure for fire fighting purposes. The fouling of gate valves and other equipment can also result.

While the requirements of the industrial consumer are usually much more stringent than those of the domestic user, the removal of iron and manganese from domestic water supplies to within the suggested limits of the USPHS would considerably alleviate the treatment problem of the industrial user.

The softdrink, brewing, confectionary, ice manufacturing, laundering, plastics, and textiles industries are a few that require less than the USPHS requirement (for domestic supplies) of not more than a total of 0.3 ppm. of both iron and manganese. Obviously the industrial water user has a much more acute problem than the domestic consumer. The results of excess iron and manganese being present in process water can produce effects varying from the changed chemical composition of a product to the loss of sales appeal due to the unattractive appearance of the product.

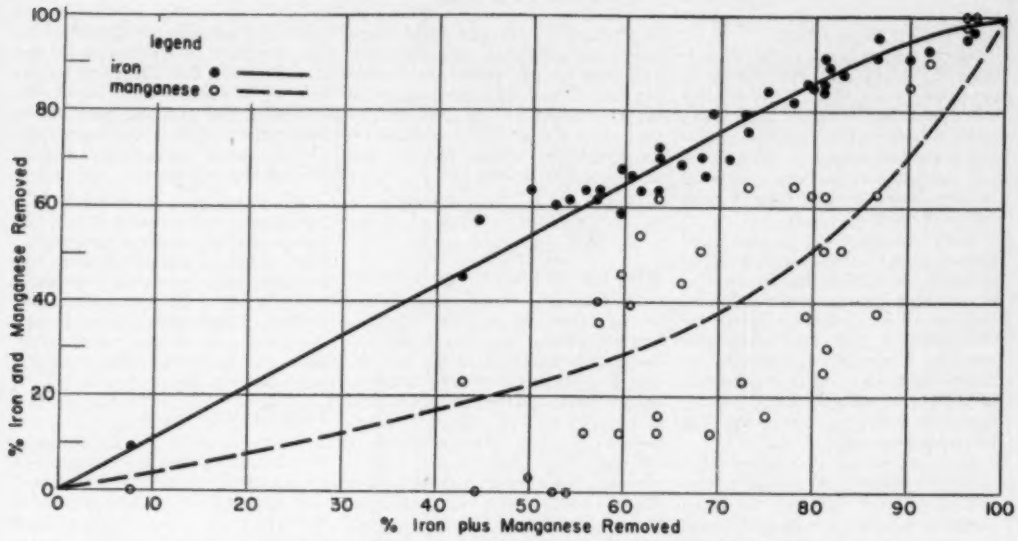

Fig. 1—Relative Quantities of Iron and Manganese Removed by Chemical Precipitation.

Sources of Iron and Manganese

These two minerals can come from a number of sources. In surface waters one of the most important sources is industrial wastes, particularly from mine drainage and the metal working industries.

Ferrous and manganous minerals are reasonably abundant in soils. They will dissolve in waters of low pH, particularly in the presence of large quantities of CO_2.

The reduction of ferric and manganic compounds either in mineral or organic form is another source; this process can take place in deep reservoirs due to anaerobic decomposition of organic matter.

From the preceding facts it appears that a water supply now free of iron and manganese will not necessarily remain so indefinitely. For example, when the ground water table is low or the quantity of water taken from a well is in excess of that normally pumped, the quantity of iron and manganese in these waters will increase during those periods and return to normal when the pumping rate or water table assumes normality.

This phenomena may possibly be caused by the increased velocities that occur in the well vicinity, bringing more CO_2 in contact with each volume of soil. This results in more iron and manganese going into solution from the ferrous and manganous compounds present.

Iron and manganese can occur either in a reduced or oxidized form in water. Iron usually exists in surface waters in one of the various oxidized forms because it only requires 0.14 ppm. of oxygen to oxidize 1 ppm. of iron. Ground waters being devoid of oxygen in general usually contain iron in a reduced form in solution. These same anaerobic conditions also lead to the formation of H_2S through the reduction of sulfates by sulfur bacteria which may result under the proper conditions in the formation of a metallic sulfide such as FeS.

Iron bacteria (Gallionella, Leptothrix, Crenothrix) have the ability to derive energy from the oxidation to the ferric state of ferrous iron in solution. The growth of those organisms on well interiors and in pipelines can produce undesirable tastes and impair hydraulic characteristics. Sulfur bacteria, notably vibrio desulfuricans, reduce sulfates to hydrogen sulfide in the absence of oxygen. The odor of hydrogen sulfide is quite often noticed in the vicinity of iron removal plants and wells. The previously mentioned conditions probably account for it. The oxidation of ferrous iron to FeS probably results from the indirect action of sulfur bacteria. If this odor is noticed in an iron-bearing water supply, it is reasonable to assume that the iron exists in a ferrous form.

Methods of Removal

The mechanism of manganese removal is believed to be different than that for iron. Zapffe[9] has stated that manganese is removed efficiently only in the presence of active surfaces of manganese dioxide. Manganese can usually be removed by an intensification of the iron removal process which will remove the oxidized compounds of manganese occurring as colloidal precipitates. Figure 1 helps to illustrate these points. The relatively low degree of scatter for iron indicates that the mechanism follows a single route, while the wide dispersion of manganese indicates a complex combination of several mechanisms.

It is interesting to note the comparatively low degree of manganese removal realized until the total removal begins to approach 100 per cent. The per cent manganese removed was less than the per cent iron removed until the total per cent removed exceeded 95 per cent. The data from which this plot was made comprised both jar tests and pilot plant results using the Spaulding precipitator. Segregation of the data did not substantially alter the picture. Where both iron and manganese occur together, which is quite common, the substantially complete removal of iron will many times bring the total residual of both to within the USPHS requirements.

The compounds which are most likely to precipitate in natural waters are:

$Fe(OH)_2$	$Mn(OH)_2$
$Fe(OH)_3$	$MnO(OH)_2$
	$Mn(OH)_4$

Other compounds which may precipitate are $FeCO_3$ and FeS.

These metals may occur as colloidal $Fe(OH)_3$ and $MnO(OH)_3$ in the presence of oxygen. The colloids will appear milky rather than chocolate in color. Although this condition is temporary and the compounds will coagulate in time, their removal is more difficult than that of non-colloidal oxidized forms.

The presence of tannins and humins in the water has the effect of seriously inhibiting the removal of iron and manganese. These stabilized colloids act as protective agents for the colloidal iron and manganese present. They are not readily removed by oxidation. It is necessary to destroy or coagulate the organic matter in order to remove the iron or manganese it protects.

Many of the texts on water treatment sadly neglect the subject of iron and manganese removal. In many cases, it requires considerably more to remove these materials than the usual oxidation or chemical precipitation process that is described.

Weston[1] has said that there are three classes of iron-bearing ground water:

(1) Those that begin to precipitate immediately after aeration
(2) Those in which iron is not easily precipitated by aeration (acid water)
(3) Those which precipitate part of the iron readily but hold the remainder indefinitely.

Of these three types the second is the one which will cause the greatest number of complaints because of after-precipitation either in the mains or in household containers.

Manganese usually occurs in the reduced form in ground waters. Its removal requires that it be oxidized to the manganic form. This requires a relatively high pH in the neighborhood of 9.0. At the proper pH it is relatively easy to oxidize by aeration with subsequent removal on filters. Over long periods of time a slow sand filter will develop a coating of manganic compounds on the surface of the top sand grains which will then act as a catalytic surface for the removal of unoxidized and colloidally oxidized manganese. This procedure has the distinct disadvantage that the sand grains are gradually enlarged with resulting changes in the hydraulic characteristics of the filter.

Oxidation

One of the earliest methods to be employed for iron and manganese removal consisted of aeration over coke beds or other objects (in order to produce a large gas-liquid interface), sedimentation and filtration. The aeration performed the double process of aerating the water to supply oxygen for the oxidation of the iron and manganese and the release of CO_2 which reduced the acidity and raised the pH.

$$4\,Fe^{++} + 8\,HCO_3^- + O_2 + 2H_2O = 4\,Fe(OH)_3 + 8CO_2$$

$$Mn^{++} + 2\,HCO_3^- + \tfrac{1}{2}O_2 = MnO(OH)_2 + 2\,CO_2$$

In both cases the CO_2 is removed by aeration.

The reaction usually takes place by one of the above paths. The iron and manganese is oxidized, but unfortunately many times the individual particles are so minute as not to readily settle and they are apt to pass through about ½ of the filter depth before stopping. The result is a plugged filter that is not readily cleaned. This, in combination with the top sand grains being enlarged by the deposition of manganic compounds, is apt to make the cleaning of slow sand filters a continuous process and produce excessive head losses when rapid sand filters are backwashed.

If the water contains any organic matter, and many iron and manganese-bearing well waters do, the result is quite often a plugging of the prefilters onto which the aerated water falls. This results in a condition which looks very much like a "ponded" trickling filter and often will totally disable the prefilter. (See accompanying photograph)

Many variations of this type of plant exist. Howard[9] added a marble chip bed between the prefilter and filter which improved the pH conditions and hence the precipitation. The action of the marble is the same as that of adding lime to increase the alkalinity and neutralize the CO_2.

Chemical Precipitation

The application of coagulants to an iron and manganese-bearing water supply can be an effective method of removal. Basically the chemical precipitation of iron and manganese is very similar to its removal by aeration and filtration.

Many waters require that the pH be raised in order to oxidize the iron and manganese; this can be done both by aeration and the addition of an alkaline material such as lime. The addition of lime or soda ash alone can usually affect the necessary change in pH, but many times economics will dictate a combination of aeration and the addition of an alkaline material. The added alkalinity performs the multiple work of neutralizing CO_2, raising the pH, and providing the required alkalinity for the coagulant to react with for the formation of a floc. The floc provides a charged surface onto which the settleable and colloidal particles of iron and manganese compounds are able to attach themselves, resulting in settleable particles.

The application of chemical precipitation to the removal of iron and manganese will usually do effective work on those waters in which the iron and manganese is colloidally oxidized and protective colloids are present. Conventional aeration and filtration plants usually will break down and fail in the presence of this particular combination.

Solids-Contact Process

The term solids-contact refers to the various pieces of equipment such as the "Hydrotreator," "Accelator," and "Precipitator" which all utilize the effect of solids contact either through a "slurry pool," "sludge blanket," or other means depending upon the particular type of equipment. All of those devices produce by one means or another the intimate contact of the untreated water with the previously formed floc or sludge.

The efficiency of this type of equipment and its comparison on an experimental level with conventional chemical precipitation and filtration has been made by the author at Lowell, Mass. Figure 2 is a comparison between the existing aeration and filtration plant at Lowell with the pilot plant which incorporated the Spaulding Precipitator as a solids contact unit. The results of the existing treatment plant were those observed at the same time as the pilot plant was in operation. This comparison serves to demonstrate both the efficiency of final removal, the relief that was afforded the slow sand filters, and the comparative efficiency of conventional chemical precipitation.

A study of the costs of construction and operation of conventional chemical precipitation units and solids-contact process units reveals that the latter is usually more economical. The short detention period of these basins as compared with conventional settling basins and the considerable savings in chemicals both account for this conclusion.

Chemical Treatment

The chemical treatment of iron and manganese-bearing waters usually includes two major items; namely, chlorine and "Calgon" or hexametophosphate.

The first of these, chlorine, is an aid to removal rather than an independent means of removal. This powerful oxidizing agent can perform its work in one of several ways.

If protective organic colloids are present, their destruction by chlorination places the iron and manganese in a position to be removed by other means.

The treatment by quantities of chlorine in excess of that required for the destruction of the protective organic colloids which may be present can oxidize the iron and manganese which then reacts with the alkalinity present to form ferric hydroxide and manganic hydroxide. This is the usual reaction which takes place at the pH generally present in water. Attempts to aid the removal of iron and manganese where there is insufficient alkalinity present to complete the reaction will fail unless it is provided by artificial means.

The use of chlorine has particular application in those aeration-filtration installations which are operating inefficiently. Quite often the addition of chlorine at the proper point in the treatment process will considerably improve the efficiency of an existing installation. In the final analysis, chlorine is an oxidizing agent. Although its relative efficiency is much greater than oxygen, it nevertheless can only oxidize iron and manganese under the conditions found in most waters. Its chief attribute is its ability to destroy organic matter. This agent can be an important aid to the removal of iron and manganese, but if it is improperly applied little or no improvement in removal will be observed. The result is that another valuable aid to water treatment may receive a black mark.

The application of hexametaphosphate to iron and manganese-bearing waters has gradually been rising to a position of importance since the introduction of this material on the market about 1938.

The original application of hexametaphosphate to water supplies was for purposes of preventing corrosion. This is done by placing a thin protective layer on the interior of water mains by solution feed to the system. Its ability to reduce hardness is similar in action to its ability to prevent the precipitation of compounds of iron and manganese.

The application of hexametaphosphates to a water supply is best done before the water is aerated or chlorinated to any degree. The general recommendation for domestic water

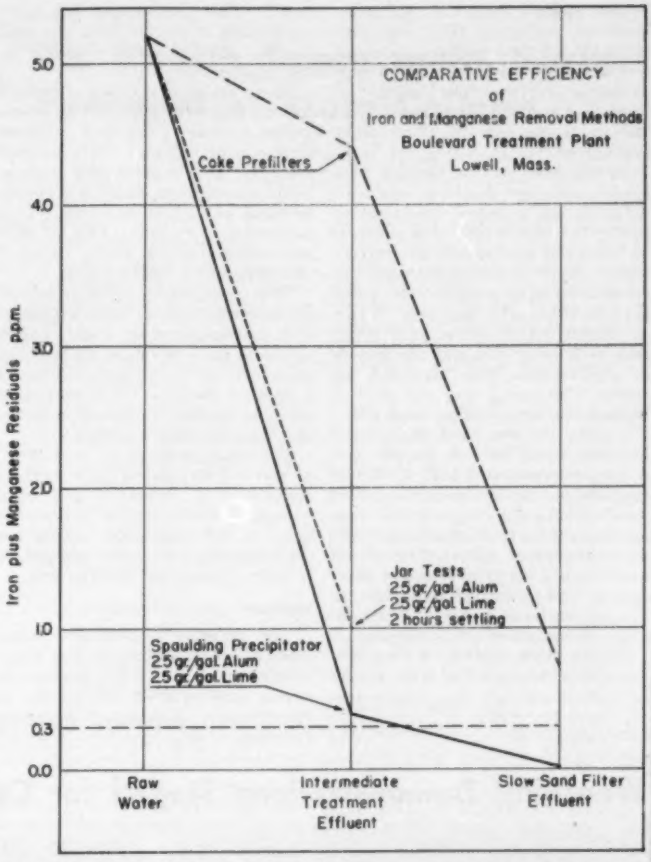

Fig. 2—Comparative Efficiency of Iron and Manganese Removal Methods, Lowell, Mass.

is the application of an amount equal to twice the quantity of iron and manganese present. Water treated with four parts of hexametaphosphate for every part of iron and manganese present can be used for normal household purposes without showing the presence of iron.

This material has particular application to those supplies which contain iron and manganese in quantities too small to justify the construction of an iron and manganese removal plant but which nevertheless produce an unsightly water. This material again is one which when improperly applied will fall short of expectations and again do damage to the reputation of a tool which can be untold aid when properly appraised.

Zeolites

The removal of iron and manganese through the use of zeolites proceeds via the mechanism of ion exchange. Any of the straight zeolites such as natural green sand, synthetic zeolites, and organolites can be used; however, the organolites will replace the iron and manganese with hydrogen when it is operated on an acid cycle. The mechanism for sodium cycle zeolites is as follows:

$$Na_2Z + Fe^{++} = FeZ + 2Na^+$$
$$Na_2Z + Mn^{++} = MnZ + 2Na^+$$

If the ion exchange mechanism were the only consideration, zeolites would have a much wider application than they now enjoy. The most serious drawback is that the iron and manganese must be in a reduced form (i.e. ferrous, manganous) for the ion-exchange reaction to take place. If the metals occur in an oxidized form, the zeolites will not remove them and a plugged bed will result. Therefore a closed pumping system must be used in order to prevent aeration and subsequent oxidation.

The occurrence of iron and manganese in colloidally oxidized com-

pounds renders them unfit for treatment on zeolite as they will pass through the bed without removal and will not take part in an ion-exchange reaction. The presence of protective organic colloids will disable a zeolite bed in short order through plugging.

Zeolite beds can be cleaned with caustic soda and alum but only with difficulty and eventual deterioration of the bed will result. The removal of iron and manganese on conventional zeolite filters is economically feasible on large supplies only when it exists along with hardness. A rule of thumb that is often used states that to remove iron and manganese in conjunction with hardness on zeolite filters and have the process remain efficient requires that every 0.5 ppm. of iron and manganese removed must have 1 gr. per gal. of hardness removed with it. Water supplies having the combination of chemical characteristics which permit this rule to be used are relatively rare. In general, waters that contain more than 2 ppm. of iron and manganese and in quantities exceeding 5 mgd. can be treated more economically by means other than zeolite.

Zeolite beds that have been exhausted with regard to their ability to remove calcium and magnesium still have the ability to remove iron and manganese in this "twilight zone." This phenomenon has some application where zeolites are used for the removal of hardness, iron, and manganese.

There are several types of treated zeolites that are primarily for manganese removal. The first of those is MnO_2 or "Birm." This method acts only as a contact bed, oxygen being the oxidizing agent. Pyrolusite (natural MnO_2) is also used. This material is very heavy (sp. gr. 3.5) and is therefore not readily loosened or expanded by backwashing.

True manganese zeolite is regenerated with sodium permanganate. The reactions are in doubt, but it seems to be a question of building up a layer of high-valent oxides on a contact surface. This particular material has applications in industry and has been quite successful.

The use of zeolites for the removal of iron and manganese finds its chief application to industrial and small municipal water supplies. Within the scope of its application, zeolite for the removal of iron and manganese is both efficient and trouble free.

Summary

The presence of excessive quantities of iron and manganese in water supplies produces various undesirable effects ranging from the esthetic to the economic. The form of its occurrence and its effective removal covers the gamut of water chemistry. If a detailed analytical study of such waters is not made prior to a decision as to the type of treatment, subsequent failure is apt to result. This particular problem is one which still requires pilot plant studies in many cases. Funds spent on such studies usually prove the wisdom of the decision in long periods of effective trouble free operation of the prototype treatment process.

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Trenching Demonstrations Staged for California Water Group

The Southern California Water Works Group is composed of water works operators from Santa Barbara, Calif., and south. The Group meets monthly in various cities. At the Compton meeting a demonstration of trenching was put on with the three mobile trenching machines built in California.

The accompanying pictures were taken during the demonstrations observed by about 100 members of the Water Group, and almost as many interested contractors and other public utility men.

The three machines demonstrating were: the "Profit Trencher" (Constr. Products Corp., Los Angeles); the "Trenchmaster" (Trenchmaster Inc., Alhambra); the "Be-Ge" (Be-Ge Mfg. Co., Gilroy).

The demonstration was made to prove that one machine operator with a mobile trenching machine can do the work of many men doing hand trenching, and at a far lower cost. With the scarcity of hand labor, and present day wages, hand trenching costs roughly $1.00 per foot, as against 5 to 40 cents per foot when done by machines. The speed with which the job is done is another not-to-be-overlooked advantage. Just the operating costs of a mobile trencher is 1 cent per ft. or less. Emphasis was placed on the fact that it is not the long pipe line that costs the most, it is the numerous small jobs which must be done from day to day that the mobile trenchers can do quickly and economically. The demonstration was considered highly successful, informative and revealing.

Pa. Health Department Night Featured at State College

24th Convention of Pa. W.W.O.A.

PENNSYLVANIA Department of Health Night was the feature of the 24th annual meeting of the Pennsylvania Water Works Operators Association, held this year again at State College, Pa., on Aug. 19-22.

Two hundred forty two men and 64 ladies registered for the sessions held in the Temporary Union Building, on the campus of Penn State College. Among the unusual activities of this meeting were the presentation of the first Ivan M. Glace Award, and the passage of a Voluntary Certification Plan.

In addition to the refreshments served following the Monday night session, the ladies were treated to a bridge party, a luncheon, and a trip through the college horticulture gardens. The men registrants indulged in a golf tournament, soft ball game, and the well known presentation of door prizes after each session.

Ivan M. Glace Award

At the Tuesday evening session, the first Ivan M. Glace award was presented to LEON S. DUCKWORTH, Supt., Lancaster Filter Plant for his longtime service to his community, his fellow workers, and the association and his especial effort along the lines of public relations. The award is named for and in honor of I. M. (Mike) Glace, Cons. Engr. of Harrisburg, who was one of the founders of the Association, and who retired last year as Secretary after 23 years service in that office.

New Officers

The following slate of officers presented by the nominating committee (Ted H. Kain, Chair.) was unanimously elected for the ensuing year.

President
I. M. Glace, Cons. Engr.
Harrisburg, Pa.

1st Vice President
L. D. Matter, Asst. Ch. Engr.
Pa. Dept. of Health
Harrisburg, Pa.

2nd Vice President
B. F. Johnson, Chem.
New Castle Water Co.
New Castle, Pa.

Secretary-Treasurer
R. Rupert Kountz,
Prof. San. Engr.
Penn State College
State College, Pa.

Operators Certification

Under the chairmanship of L. S. DUCKWORTH, Supt. of Filt., Lancaster, Pa., a committee had developed, during the past year, a Voluntary Certification Plan for water works operators. Although a number of comments were made on various details, no serious objections were made to the general provisions and the plan was passed unanimously after it was amended to include a grandfathers clause. This clause assures each present operator of a certificate for his present plant only; if he desires the general certification, he must make application in the usual manner.

The program is open to all men actively employed, or who have qualifications of education and experience as water works plant operators and to regularly employed assistant operators. Application is not restricted to membership in the Pa. Water Works Assn., but the certificate is issued by the Association. It has no official recognition by the State Department of Health.

The plan calls for a certification board of three members who have a wide latitude in the certification of applicants, based on experience, education, and examination if necessary. A license fee of $1 a year will be charged. Four classes of operators will be set up, with classifications of plants being set forth for both surface and well supplies. The plan includes definitions of "operator," "water treatment plant," and "water supply system." Provisions are made for revisions of the plan after one year.

Honorary Memberships

As in the tradition of many years, the Association meeting was greeted by DR. H. P. HAMMOND, Dean of Engineering of The Pennsylvania State College. Inasmuch as Dean Hammond is retiring before the beginning of the new school term, this was his last appearance before the group. Appropriately, President Paul P. Merkle, Cons. Chem., Reading, Pa., presented Dean Hammond with an Honorary Membership certificate for the Association. Dr. Hammond introduced the Honorable DR. RUSSELL E. TEAGUE, Secretary of Health of the Commonwealth of Pennsylvania. Dr. Teague was also presented with a Certificate of Honorary Membership in the Association.

Past Pres.
P. P. Merkle
Cons. Chem.
Reading, Pa.

President
I. M. Glace
Cons. Engr.
Harrisburg, Pa.

1st Vice Pres.
L. D. Matter
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Harrisburg, Pa.

2nd Vice Pres.
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Chemist
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New Castle, Pa.

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R. R. Kountz
Prof., San. Engr.
Penn State
State College, Pa.

Honored
Hdn. Memb.
H. P. Hammond
Ret. Dean, Engr.
Penn State
State College, Pa.

I. M. Glace Award
"Mike" Glace, for whom award is named, and first recipient, "Ducky" Duckworth of Lancaster.

Health Dept. Night

"Our Department of Health" was the topic of the talk presented by Dr. Russell E. Teague, Secretary of Health.

Dr. Teague pointed out that good water has been more important to the reduction of disease than have drugs. The part the Health Department has played in improving water supplies was reviewed by Dr. Teague who briefly sketched the history of the Health Department and the Bureau of Engineering, created in 1905.

Practically all of the water plants in the state have come into existence since 1905. Records show that in 1906 there were 3917 cases of typhoid fever and 54 deaths per 100,000 population. In 1949 there were only five cases (none water borne) and 0.04 deaths per 100,000 population. While safe milk has been important in the reduction of this disease, the development of safe water supplies has been even more important.

Dr. Teague paid tribute to the water works operators and their close cooperation with the representatives of the health department. Dr. Teague also commented on other work of the Health Department saying that such activities are not socialized medicine in any sense of the word. He decried the lack of trained public health personnel in the state and said that he hoped the development of a merit system would help to alleviate that condition. Local health departments in districts are to be set up and staffed as fast as trained personnel can be obtained. These activities are all part of a long range program to improve the department.

"Introduction of Engineering Bureau Personnel" by H. E. Moses, Consulting Chief Engineer, Bureau of Engineering, Pa. Dept. of Health.

Mr. Moses reviewed the work of the Bureau of Engineering, the growth of water treatment, particularly chlorination since 1909. He then introduced approximately 75 of the engineers on the Bureau staff. Some thirty-eight were unable to be present at the meeting. A group photograph of those present was taken.

Following this activity, a movie was shown: "Waters of the Commonwealth." This motion picture is a professional job prepared for the State by the Jam Handy Studios of Detroit. It shows how the waters of the commonwealth are used, and how many of them are polluted by sewage, industrial wastes, coal washing and acid mine drainage. It is an excellent motion picture. Arrangements for showing the film can be made through the Pa. Dept. of Public Health.

Mrs. A. E. Griffin and Mrs. R. R. Kountz

Freeburn Cup Award Paper

"Photography in the Water Works Laboratory" was the title of the paper prepared by F. R. Perrin, Chemist, South Pittsburgh Water Co., Pittsburgh, Pa. This paper had been chosen as the winner of the H. M. Freeburn Cup, given annually to the best paper by an opeartor.

Mr. Perrin described the many types of interesting photographs which could be obtained at a water works. Included in his list of pictures were the inside of a meter being repaired; these were taken in color. The inside of encrusted pipes and cross sections of the encrustation also made good color photography subjects. Inside shots of elevated tanks, showing closeups of the area and depth of pits, and the amount of corrosion at rivet heads, likewise are well worth recording.

Black and white photographs of construction pay off, said Mr. Perrin. The story of water treatment is also a good subject. Mr. Perrin uses 35mm. film and a reflex camera, with a portrait lense for close work. Tripod and lighting as well as a light meter are also necessary equipment. The cost is less than $200 for equipment.

The Schuykill River

"Changes in the Schuylkill River" by Samuel Crawford, Senior Bacteriologist, and Walter C. Ringer, Sanitary Engineer, Bureau of Water, Philadelphia, Pa.

For years the Schuylkill River at Philadelphia has been heavily polluted with sewage, industrial wastes and coal culm. With recent years, phenol wastes have been removed for the most part, but the bacterial pollution still exists. Work of the State on the dredging of coal culm from the upper part of the River has been completed, but the lower section which was to be dredged by the Federal government is still to be accomplished and Congress has made no appropriation for the work.

Although coal culm presented a problem in that it had to be removed from settling basins, its presence was an aid to coagulation of the clay turbidity. There has been a reduction in turbidity and oxygen consumed values with the removal of coal culm discharge to the rivers by the collieries.

Atomic Bombs
Geo. W. Moore
San. Engr.
N.Y. St. H'lth Dept.
Albany, N.Y.

Carification
R. J. Faust
Exec. Asst. Secy.
A.W.W.A.
New York City

Mr. Crawford said that when the coal culm is all cleaned up, the people will applaud, but only the complete removal of industrial, domestic, and organic wastes will fully improve the quality of the water received at the filter plant.

Mr. Ringer showed photographs of a presettling basin which had been filled with 18 feet of settled coal culm. Prior to the cleanup of this problem by the coal washing companies, the intake to the filter plant had to be dredged regularly in order to get water into the plant. Now the dredging is less frequent. It is also necessary to clean the settling basins at less frequent intervals and still maintain them in good operating condition.

According to Mr. Ringer, about the only noticeable change to date is in the per cent of the time that the turbidity of the raw water is less than 25 ppm. With the decrease in turbidity, algae are beginning to grow in the river, and algae tastes may become a problem. Although total coal culm introduced into the river is less than heretofore since June 1951, the Park

Commission at Philadelphia had to dredge 132,465 cu. yd. of culm from the vicinity of the water works. This operation is costly. Philadelphia is looking forward to the time Federal Government completes its share of the clean up project.

Well Maintenance

"Well Maintenance" by J. B. Murphy, Engineering Dept., Amer. Water Works Service Co., Philadelphia, Pa.

Inspection of wells is important, but it is costly to set up a standard inspection schedule. From a questionnaire submitted by all operating units of this company, it was determined that the slower the operation of a well pump, the longer time that could

Wells
J. B. Murphy
Mech. Engr.
Am. W. W. Serv. Co.
Philadelphia, Pa.

River
W. C. Ringer, Jr.
San. Engr.
Bur. of Wat.
Philadelphia, Pa.

be allowed between inspections and repairs. Pumps operating at 800 rpm. had run as much as 51,000 hours, while pumps operating at 3450 rpm. had to be inspected and repaired at 8000 hours. On the basis of this study it was decided to establish a maintenance inspection schedule according to the individual installation from two to five years.

Mr. Murphy showed slides on the safe handling of well pumps when pulled for overhaul. He recommended power hoists. On the matter of screen clogging, he suggested that the specific capacity (gpm. per ft. of drawdown) is the tip off. For improving well capacity, his company had tried Calgon and HTH, each showing some improvement of individual wells. Acidizing has also been used to regain well capacity. If acid is used, it is best to hire the treatment done. Dry ice added in several different ways was of no help. Surging may cause a loss of the well. A new treatment to improve rock wells is the use of shaped charges. This type of blast does not fill the well with rock. Improvement was marked in one well.

Certification of Operators

"Certification of Water Works Operators" by Raymond J. Faust, Exec. Asst. Secy., Amer. Water Works Assn., New York, N.Y.

Prior to the business session of the meeting and the discussion of the voluntary certification, Mr. Faust reviewed the results of 20 years of experience in Michigan where he served on the certification board for many years while he was a member of the health department of that state.

In Michigan, there are seven classes of operators for plants from the simple to the most complex. About 50 per cent of the applicants for the examination pass the tests.

Atomic Bombs

"Water Supplies and Atomic Bombing" by George W. Moore, Asst. Chief, Water Supply Section, Bur. of Environmental Sanit., State Dept. of Health, Albany, N.Y.

Mr. Moore opened his talk at the Tuesday evening session by issuing three warnings to his audience: (1) "Do not believe that attomic bomb forces can be controlled and therefore there is no need for preparation to meet the problem" (2) "Do not become hysterical with fear and for that reason fail to make any preparation for the possibility of bombing." (3) "Do not believe that the bomb may never be used and for that reason make no preparation for the possibility."

Mr. Moore pointed out that Americans had experienced disaster before but all of the floods, fires, earthquakes, tornadoes and other damaging forces are minor compared to the terrific destruction of life and property by an atomic bomb. The atomic bomb and its destruction is also far greater than any effects of ordinary high explosives. Furthermore there is a difference in the action of the atomic bomb.

Within a one-half mile radius of ground zero, everyone will be killed and all structures destroyed. Killing effects are three: searing heat, supertornadic blasts, and radiation effects. Beyond a 1½ mile radius, few will be killed but 80 per cent of the population will be injured. Outside a 2½ mile radius effects will be few.

The heat will be so intensive that wooden structures will immediately burst into flames. The infrared rays which travel with the speed of light will be so intense that no life will be possible. Blast effects produce wind velocities of 800 miles per hour at 1000 feet from ground zero.

After an air burst, there will be little residual radiation, but the immediate radiation will be high for several minutes. Radiation will consist of Alpha and Beta particles and Gamma rays.

H. M. Freeburn Cup
Won by F. R. Perrin, Chem., So. Pitts. Water Co., for paper on photography.

Mr. Moore said that it would be possible to drink water with a relatively high dose of Beta-Gamma effects, but the water intake should be as small as possible. These radiation effects die off in time and supplies should be fully usable in thirty days or less; meanwhile radiated supplies are not completely unusable. Furthermore, coagulation and filtration processes remove some of these radioactive characteristics in the water and since these radiation effects continue to decay with time, the water supply will continue to improve in usability.

Biggest immediate problem will be the tremendous loss of water through broken mains, fire hydrants, and house service connections. It is estimated that the immediate loss will be at the rate of approximately 750,000 gpm. in an average size community that might be a target area. Valve closing will be the first job and provision must be made for crews from outside the target area to do the valve closing.

Ground waters will be O.K. for immediate consumption, but water from exposed supplies or reservoirs should be allowed to stand for a period before use. Base exchange materials appear to be of some use in the removal of radiation effects, but boiling of water has no effect on the radioactivity of water inasmuch as normal heat

Mrs. Geo. E. Symons, Larchmont, N. Y., and Mrs. L. E. McClung, Washington, D. C.

R. Y. Sigworth
Supt. Util.
Penn State
State College, Pa.

H. H. Gerstein
Ch. Filt. Chem.
So. Dist. Filt. Pl't.
Chicago, Ill.

Programmers All

Tom Douglas
Ch. Oper.
West. Penn. Wat.
MacDonald, Pa.

J. W. Lawrence
Manager
West. Penn. Wat.
MacDonald, Pa.

R. W. Haywood
Chem. Engr.
Du Pont
Wilmington, Del.

ranges do not affect the rate of decay of radioactivity.

In answer to a question, Mr. Moore said that it would be permissible to send water works personnel into bombed areas within a short time, but they should be preceded by a monitor which will determine the length of time it is safe to be exposed under the conditions existing.

Inspection Trip

A visit to the Borough and College Wells Fields was conducted by R. Y. SIGWORTH, Supt. of Utilities, The Pennsylvania State College, his assistant, Wm. Bubb, and Mr. Clarence Jackson, Engineer, Borough of State College. Mr. Sigworth explained the geological strata from which the different wells draw water. Sand removal devices are necessary on some wells; both open and closed sand traps are used. One set of wells has a hardness of approximately 100 to 120 ppm. Another well from an entirely different strata has a hardness of 230 ppm. The College uses about 1 mgd. and has a per capita consumption of 65 gal. per day. Much of the summer pumpage goes for irrigation purposes on the golf course, football field and farms. In the winter, a student population of 10,000 (4000 on campus) uses the amount of water used for irrigation in summer so that the year round pumping is fairly constant.

Up-flow Sludge Contact Units

"MODERN TREATMENT UNITS OF UP-FLOW TYPES" were discussed by Robert W. Haywood, San. Engr., E. I. Du Pont de Nemours Co., Wilmington, Del.

Mr. Haywood stated that there are nine different makes of up-flow clarification units on the market, but that in his comments only three of the better known makes would be considered. To date 910 units of the three makes had been sold. He referred to the Spaulding "Precipitator" (Permutit); the "Accelator" (Infilco); the "Hydro-Treator" (Dorr Co.) The largest of these units sold to date had a capacity of 1000 gals. per min.

Pa. Dept. of Health Officials

J. R. Hoffert, Ch. Engr., Dr. Russell Teague, Secy. of Health, and H. E. Moses, Cons. Ch. Engr.

Mr. Haywood outlined the differences in principles of operation of the three makes and stated that the "Accelator" did not employ the sludge blanket principle, as did the other two, but emphasized the sludge contact feature ahead of up-flow clarification.

Listing the advantages from use of these modern clarification units, he cited the economy of structures; the short reaction and clarification period required; continuous withdrawal of sludge, with less waste of treated water and time lost in shut-downs for cleaning; advantages of contact of solid particles with incoming treated water, resulting often in improved treatment and/or chemical economy.

Listing the disadvantages, Mr. Haywood cited the treated water loss in continuous sludge draw-off (12 per cent in coagulation plants); corrosion of metal parts and maintenance expense; number of moving parts; often the under-design in capacity. Concerning the latter, he stated that some firms sold on the basis of 2.5 gals. per min. for each sq. ft. of surface area of tank; whereas, others sold on a basis as low as 0.75 gals. per min. for each sq. ft. of tank surface area.

As to opinions of State Sanitary Engineers, these had varied considerably with one State (Alabama) requiring as much as 6 hrs. of detention period, whereas N.Y. State accepted 1.5 hrs. as the minimum. It is also the opinion that the modern up-flow type of units require a higher degree of operating skill.

"OPERATION OF THE WEST PENN WATER PLANT AT MACDONALD, PA.," by J. W. Lawrence, Manager, and Thos. M. Douglas, Chief Operator, West Penn Water Co., MacDonald, Pa.

This paper presented in part by both authors told of plant improvements, emphasis being placed on the up-flow Spaulding Precipitator at the West Penn Water Co. plant and the use of ferric sulfate and lime for partial softening and coagulation. Flash turbidities have been handled very effectively by the up-flow unit merely by increasing the dosage of ferric

Inspection Trip

R. B. Jackson, Borough Mgr., leads trip to Borough well field (left) while J. J. Hamilton of Greensburg poses a puzzler to Martin Flentje of Am. Wat. Wks. Co. (right).

Bureau of Engineering Personnel—Pa. State Health Dept.
Approximately half of total number of sanitary engineers in the department.

sulfate. With variations of 480 to 1350 gal. per minute through the Precipitator, the effluent remains constant in suspended matter and clarity, with filter runs of 168 hours resulting. In an attempt to control algae growth which is observed in water of pH 9.5 and higher in the Precipitator, pre-chlorination had been tried. Since it had been impossible to maintain free chlorine in the sludge blanket or tap water pre-chlorination had been of little value in controlling the algae. It is now the practice to add copper sulfate to the raw water during algae periods.

In reply to a question, Mr. Douglas said that it was good practice to completely dump the 7 ft. sludge blanket at 6 month intervals. Ordinarily the blanket is held 6 ft. beneath the overflow weirs. After dumping a week is required to get the up-flow unit back to balance and usual efficiency.

Odor Evaluation Apparatus

"THE CONTINUOUS ODOR EVALUATION APPARATUS OF CHICAGO" was described by H. H. Gerstein, Chief Filtration Chemist, South District Filtration Plant, Chicago, Ill.

Mr. Gerstein's paper was essentially the same as one given by him before the A.W.W.A. at Miami. It comprised an illustrated description of a combination of small Rotameters and valve adjustments for the purpose of

mixing a continuous stream of water to be evaluated for threshold odor value and odor free water. The mixture, in known ratio, is sprayed cold or heated and sprayed beneath a bell-jar in the top of which is a sniff-hole for the analyst or operator to take odor sniffs. Where free residual chlorine is present, thiosulphate solution is injected to destroy the odor masking chlorine. The entire set-up cost less than $100 for materials and equipment and supplies a means of making a rapid on the spot test for odor value. It however does not take the place of the more exact laboratory test, according to Mr. Gerstein. Odor free water is obtained through a 4 in. contact tower containing 6 ft. of granular activated carbon. The Rotameter eradings give the ratio of tested water and odor free water and a ratio chart reveals the threshold number.

Harry R. Hall Retires

Completes 33 Years With Wash. Suburban Sanitary District

Harry R. Hall, who has been connected with the Washington Suburban Sanitary District since its formation in 1918, has recently retired after 33 years of service to the District.

From the Maryland State Dept. of Health, which Mr. Hall had served as assistant chief of the Bureau of Sanitary Engineering for 6 years, he went with the Washington Sanitary District as deputy chief engineer under the late Robert B. Morse when the District was organized. Upon the death of Mr. Morse he became chief engineer in 1918, which position he has held for the past 15 years. His 33 years in the service of the Washington Suburban Sanitary District, together with his 6 years as deputy chief of the Maryland Bureau of Sanitary Engineering, totals 39 years of credible service in the field of public health in the State of Maryland.

Mr. Hall was a native of Boston, Mass., and a graduate from the Mass. Institute of Technology in 1907, after which he served as an assistant sanitary engineer with the Mass. State Dept. of Health for four years. From this position he went to the Maryland Dept. of Health as deputy chief engineer at the time of the establishment of a Sanitary Engineering Division in the Department. He is a valued member of a great number of professional societies and associations and recipient of the Geo. W. Fuller Award of the American Water Works Association in 1948, being cited "for advancement of the water works profession, and effective service in the field of sanitary engineering, particularly as chief engineer of the Washington Suburban Sanitary District."

New Lawrence Experiment Station Planned

Plans for a new station to replace the present "venerable" Lawrence Experiment Station of the Mass. State Dept. of Health are under way. The Lawrence Experiment Station, located in Lawrence, Mass., gained renown in the field of sanitary engineering for the contributions to water and sewage treatment practices which came out of studies conducted there by young engineers later becoming famous. Amongst these were Geo. W. Fuller, Allen Hazen, Robert Spurr Weston, and others who became pioneers in the sanitary engineering field. The station was established in 1887.

THE EDITOR'S COMMENTS

Better Sewer Maintenance Is Profitable

If you have any interest in improved sewer maintenance read "The Savannah Sewer Story" in this issue, by Henry W. Jenkins. This is another case which spotlights the much to be desired trend in recent years to improved sewer maintenance. In Savannah's decision to institute better and more routine sewer maintenance a considerable expenditure was made to equip the Sewer Department with modern equipment which has taken much of the drudgery out of sewer cleaning and maintenance, while also reducing dependence upon manpower, made possible by greater dependence upon horsepower and more certain results. We believe that the number of sewer cleaning units purchased at one time by Savannah, comprising a full carload shipment, constitutes something of a record purchase of sewer maintenance equipment.

We referred to the much to be desired trend toward improved sewer maintenance observed in recent years because of the results noted whenever routine sewer maintenance is instituted. Far too few appreciate the fact that there is more to good sewer maintenance than correcting odor nuisance from manholes, catch-basins and vents; or the alleviation of cellar flooding due to partially choked or clogged sewers; or the increased capacity of sewers which are freed of roots and heavy grit which strands. The hidden value in clean sewers is the effect of freely flowing sewers on sewage quality and operating problems as well as costs in sewage treatment. It has been well demonstrated that clean, free-flowing sewers deliver a fresher and less odorous sewage to the treatment plant. Fresher sewage, in turn, is amenable to a higher removal of oxygen-demanding solids in the primary process of sedimentation, requires less chlorine for effective disinfection. In the secondary phase of oxidation, the residual organic content of settled fresh sewage being markedly lower than that from a septicized or degraded sewage, the loading imposed on such secondary processes is notably less. Likewise the stunning effects of septic sewages on aerobic organisms is a matter of consequence in many instances, notably in the activated sludge process. And, in the latter, there is a lesser power requirement to establish and maintain a more desirable environment for the agglomerating and oxidizing organisms. This in turn means economy in air input and power. All in all, maintaining clean sewers is a paying investment in overall operating economy where sewage treatment is involved.

It is our belief that every short school for sewage works operators would be performing a much needed service by establishing regular courses in modern sewer maintenance and in emphasizing this important phase of sewage disposal to a greater extent than has heretofore been the case. The motto for this new course might well read, "A little prevention up-sewer is often worth a lot of cure at the treatment plant."

"Free Edioprise"—

The other day we picked up a copy of the well-known business paper, *Printer's Ink*, and an item under the caption "What Makes a Good Business-Paper Editor," caught our eye.

While many of our readers may not be overly interested in what makes a good technical magazine editor, we are printing excerpts from the original with some relish. If you plant managers, engineers and operators think that you are called upon at times to wear a coat of many colors, just read on.

"A good business-paper editor must be a paradox. He must produce a magazine that will interest and excite his readers, yet must not use the devices open to his general-magazine counterpart, such as fiction, sensational illustrations, ballyhoo, or overdrawn titles. He must be first with the important news, yet must not reveal confidences or trade secrets entrusted to him. He must be fearless and uncompromising, except with products or methods of advertisers. He must stir up controversy or debate without alienating anyone. He must tell the truth, but must glorify the most picayune development of a critical account. He must build reader confidence, yet find space for a greater or lesser amount of non-newsworthy puff material which deluges him from advertisers.

As a man, he is expected to be a diplomat, but also blunt and forceful. He must be shy and retiring, yet aggressive and alert. He is expected to be an expert in both publishing and his technical field, but to accept as gospel the ideas, suggestions and criticisms of the greenest ad manager. He should spend two-thirds of his time in the field, yet not exceed a limited travel budget nor put anything into type that is not edited and checked carefully. The acme of performance is original writing packed with facts, yet he must spend his working hours answering letters and requests from readers and advertisers. He must not think of profit, but is expected to answer at once and competently any question on market conditions or potential sales, including those of the maker of specialized products.

He is expected to visit each advertiser at least once a year, yet be thoroughly familiar with the plants of subscribers, and answer all mail within 24 hours. He must know his multiple technical fields and how to produce an excellent magazine, packed with name authors, well illustrated, with everything beautifully done—and all on a budget that must be held down because an editor doesn't bring in income.

He must, of course, take an active part in the professional societies in his field, yet must not allow them to take up too much of his valuable time.

With such requirements, any sane man would declare the assembling of a staff impossible. But editors are not sane; they work in a mad frenzy, rely heavily on hunches, and are as astonished as you are when their product wins acceptance."

L. H. Enslow

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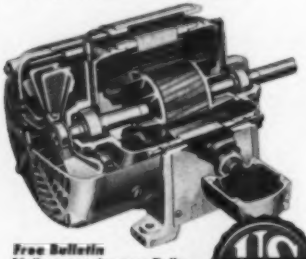

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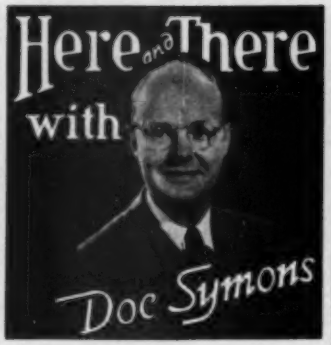

H.T.M.A.—And as I write this, it's the first "fallish" day of the year, not clear and crisp, but misty and miserable—and the smell of moth balls permeates my study.

My girl-Va. has chosen this dull day to take the autumn clothes out of storage and to put the summer finery away for another winter. I remember when she took the summer things out to air last spring in preparation for our trip to the AWWA Miami Convention in late April. I haven't forgotten other things about that trip, either.

* * *

I remember the night the golf prizes were awarded at Miami. Before dinner that evening, "Dot" (Mrs. Casey) Jones of the Simplex Valve Joneses said to us, "If I win a golf prize, will you get it for me as I can't be there."

When Frank (Electro Rustproofing) McDonald called off the ladies low net, it *was* "Dot" Jones. My girl-Va. sent me after the prize and I picked the golf umbrella. Later that night, I sent it up to the Jones' room, after assuring the desk clerk they were not in. Imagine the surprise of the bell man as he let himself in with a pass key. There stood "Dot" in her robe, creaming her face and Casey was fast asleep.—Whew!—it could have been "My most embarrassing moment for someone"—Oh yes, "Liz" (Mrs. Les.) Hart won 2nd low net, as I remember it.

* * *

Formal and informal cocktail parties enlivened the evenings. We were invited to a couple of very nice ones—one by Roy (Mr. Chlorine Dioxide) Aston of Mathieson Chem. Corp., and another by the U.S. Cast Iron Pipe boys. Some of our favorite persons—the Lloyd Nelsons, the Carl Browns, and the Les Harts, all of U.S.C.I.P.—were too busy hosting for us to have much of a chat with them, but the Browns did introduce us to Mr. and Mrs. Carl Beatus of Tennessee and it almost turned into

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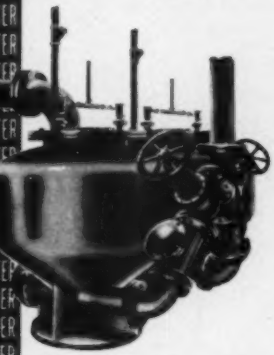

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another small world story as they had been visiting some people who live near us. When Carl told Mr. Beatus that I wrote this column, he (Beatus) cracked "Sort of a 'Who's Not Who,' eh?"—Ouch!

* * *

And that dinner dance—The fruit cocktail was a delightful creation of fresh fruit in a scooped-out pineapple; the food was hot, and the service good.

Retiring Prexy "Vic" Weir gave some sound advice to incoming "Prez" Dr. A. E. (Bert) Berry of Toronto about the proper wardrobe to take to the various section meetings. "Vic" recounted how he had taken his Tuxedo to the California meeting and not to the Virginia Section. In California he was the only one in Tux; in Virginia, the only one who wasn't. To be sure that Dr. Berry didn't make a similar mistake, "Vic" gave "Bert" a trick tie that could be used either way.

* * *

After the dinner dance, the Society of Council Bluffers met, as I told you in the July issue. This year we initiated four more Assoc. Memb.—Cons. Engr. S. T. (Shep) Powell and Mrs. Powell, and Ed. and Mrs. Showell of DuPont. "Shep" had just been made an Hon. Memb. of AWWA and Ed. was a programmer at the meeting.

As you know, too, we elected Sam (Elizabeth, N.J.) Newkirk, Bluffer Prexy because he wasn't there to defend himself. Sam later wrote me as follows, "When one questions the results of an election, he can request a recount after placing on deposit the estimated cost of the recount." Sam enclosed "1000 Liquid Currency in Water Works Wampum, redeemable only at the AWWA Convention in Atlantic City, June 14, 1939."—Sorry, Sam, the deposit falls short—You're still the Master Bluffer. "Tina" (Mrs. Wendell) La Due of Akron is Vice Pres., by virtue of having caught the breakfast check.

* * *

Following the last technical session on Friday morning, I went back to the hotel to find a sumptuous luncheon in the suite of "Lindy" (Omega) and "Benny" Harper; also present were "Les" and "Liz" Hart and my girl-Va. Just as a pleasant reminder of a nice ending to a wonderful meeting, I took this picture of the three girls—Nice kids, don't you think?

* * *

That same afternoon, I got together my notes in order to write the story of the meeting. At the same time, many others were packing to take the boat for an excursion week-end in Havana. By six o'clock the boat was ready for departure and my typewriter was unlimbered.—As the boat whistle blew and the ship slipped away from the dock, I stuffed a sheet of paper in the typewriter and beat out the following, "It wasn't the largest convention ever held, but it certainly was one of the best; and Miami, Fla., and the Fla. Section can both take a bow for the part they played in hosting the 71st AWWA Convention."—That deathless prose, which along with a few thousand other words that took most of that night and another day to finish, appeared in the June issue of *W. & S.W.*

(*Continued on page* 100A)

Because a cement lining can be thin, yet structurally sound, and because cement prohibits corrosion, the flow capacities of Centrilined pipes are often greater than when the pipes were new! . . . The smooth cement surface reduces pumping costs and seals holes caused by external and internal corrosion . . . The Centriline process, which mechanically applies cement by centrifugal force, then trowels the surface smooth, gives your pipe lines a new lease on life . . . at a fraction of the cost of laying new pipes.

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MEETINGS SCHEDULED:

Oct. 3-4—Charleston, W. Va. *(Daniel Boone Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Glen O. Fortney, State Health Department, Charleston, W. Va.

Oct. 4-5—Charleston, W. Va. *(Daniel Boone Hotel)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, H. K. Gidley, State Department of Health, Charleston 5, W. Va.

Oct. 8-11—St. Paul, Minn. *(Municipal Auditorium)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSN'S. (Annual Convention) W. H. Wisely, 325 Illinois Building, Champaign, Ill.

Oct. 10—Waterville, Maine
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, Winthrop Water District, Winthrop, Me.

Oct. 14-17—Fort Worth Texas *(Hotel Texas)*
SOUTHWEST SECTION A.W.W.A. Sec'y, L. A. Jackson, Memorial Auditorium, Little Rock, Ark.

Oct. 18-20—Corpus Christi, Texas
NATIONAL ASSOCIATION OF CORROSION ENGINEERS. (South Central Region.) Sec'y, A. B. Campbell, 919 Milam Building, Houston, Tex.

Oct. 22-24—Pittsburgh, Pa. *(Hotel William Penn)*
THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, (12th Annual Water Conference). Sec'y, W. M. Porter, Hotel William Penn, Pittsburgh 30, Pa.

Oct. 22-25—New York, N.Y.
AMERICAN SOCIETY OF CIVIL ENGINEERS. (Annual Meeting). Sec'y, William N. Carey, 33 West 39th St., New York 18, N.Y.

Oct. 23-26—Atlantic City, N.J. *(Hotel Claridge)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, W. A. Kufs, 510 Telegraph Bldg., Harrisburg, Pa.

Oct. 23-26—San Francisco, Calif. *(Fairmont Hotel)*
CALIFORNIA SECTION A.W.W.A. Act.-Sec'y, Lee Streicher, Box 38, LaVerne, Calif.

Oct. 25-27—Dubuque, Iowa *(Hotel Julien)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 25-27—Atlantic City, N.J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.

Oct. 28-31—Daytona Beach, Fla. *(Sheraton Plaza Hotel)*
FLORIDA SECTION A.W.W.A. and
FLORIDA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Perry M. Teepie, P.O. Box 210, Jacksonville, Fla.

Oct. 29-Nov. 2—San Francisco, Calif. *(Civic Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting) Sec'y, Mrs. W. R. Walsh, 1790 Broadway, New York, N.Y.

Oct. 31-Nov. 2—Baltimore, Md. *(Sheraton Belvedere Hotel)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl J. Lauter, 5902 Dalecarlia Place, N.W., Washington 16, D.C.

Nov. 6-7—Providence, R.I. *(Sheraton Biltmore Hotel)*
NEW ENGLAND SEWAGE WORKS ASSOCIATION. Sec'y, Walter E. Merrill, 511-A State House, Boston, Mass.

Nov. 7-9—Roanoke, Va. *(Hotel Roanoke)*
VIRGINIA SECTION A.W.W.A. Sec'y, W. H. Shewbridge, 708 State Office Bldg., Richmond 19, Va.

Nov. 12-14—Winston-Salem, N.C. *(Robert E. Lee Hotel)*
NORTH CAROLINA SECTION A.W.W.A. and
NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES ASSN. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N.C.

Nov. 15—Boston, Mass. *(Hotel Statler)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly meeting). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Dec. 3-7—Stillwater, Okla. *(Oklahoma A. & M.)*
OKLAHOMA WATER, SEWAGE & INDUSTRIAL WASTES CONFERENCE SHORT SCHOOL. Director, Foster S. Burba, Eng. Bldg., Okla. A. & M. College, Stillwater, Okla.

Dec. 10-14—Stillwater, Okla. *(Oklahoma A. & M.)*
OKLAHOMA WATER, SEWAGE & INDUSTRIAL WASTE CONFERENCE. Sec'y, H. J. Darcey, State Dept. of Health, Oklahoma City 5, Okla.

Dec. 20—Boston, Mass. *(Hotel Statler)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly meeting). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

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Specify WARREN CAST IRON PIPE...

In all sizes from 2" to 84" with all types of joints . . . and WARREN Special Castings to meet your requirements for non-standard patterns.

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55 LIBERTY STREET, NEW YORK 5, N. Y.
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- *If you are interested in sewage problems only you are kept fully informed and given much help in this field.*
- *If you are interested in both subjects you get all the information in this one monthly magazine.*

(*Continued from page 97A*)

Next day, Va. and I drove down to Key West—Key West, often referred to by the natives as "The Rock," was originally known as "Cayo Hueso" or the Island of Bones, so named by a Spanish explorer, who found the place littered with bones that told of a battle between the Carib and Calusa Indians for possession of choice fishing grounds. Pronounced Ky-o Wes-o, this was naturally corrupted into Key West in English.

Key West appears old and dilapidated; the houses are unpainted for the most part, the streets are narrow, and the restaurants I saw were not particularly inviting. Looking for a book on the Keys, I found many magazine shops which sold only comic books and quarter Mysteries, but only one real book shop, "The Book Nook," run by a foreign looking man with a goatee and an excellent command of English.

I was interested to see the beginning of U.S. Route No. 1, at the corner of Fleming and Whithead Sts. in front of the Court House and Chamber of Commerce Bldg. That same famed route runs right through my village of Larchmont, N.Y. and on to the tip of Maine.—Small World!

In Key West, I was impressed with the low sloping roofs, many with two or three combs, relics of the days when the only source of water supply was the sky. Now, fresh water for the city comes from wells at Homestead, Fla., to the north on the mainland. As we drove down the highway over the Keys, that seemingly endless 14-in. steel pipe, with mechanical joints, followed us mile after mile after mile the whole one hundred thirty—Yes, 130.

In that broiling sun, it's little wonder that the water is something less than cool when it reaches Key West; little wonder too, that the story is told of how the bituminous lining came off when the water was first sent through the main in the early 1940's.

That seemed like a mighty long supply main to me, but its engineering probably meant little to the folks of that area; they can remember the building of a railroad, most of it over water, in 1912, at a cost of $50,000,000 and 700 lives. Now all that is left of Flagler's famous railway is the bridge at Bahia Honda, where the present concrete causeway soars up over a truss bridge and you look down on the beautiful blue water from a height of 65 feet. Elsewhere, a truss bridge was split lengthwise and made into a part of the Overseas Road.

Like many another tourist, I was impressed, too, with Seven Mile Bridge from Pigeon Key to Bahia Honda, where the Overseas Road is actually over the sea for that distance. And what water it is: Blue, like nothing else you have ever seen, with coral rocks beneath, and fluffy white clouds above creating myriads of everchanging patterns of light and shadow, while birds, fish, and boats compete for one's attention.

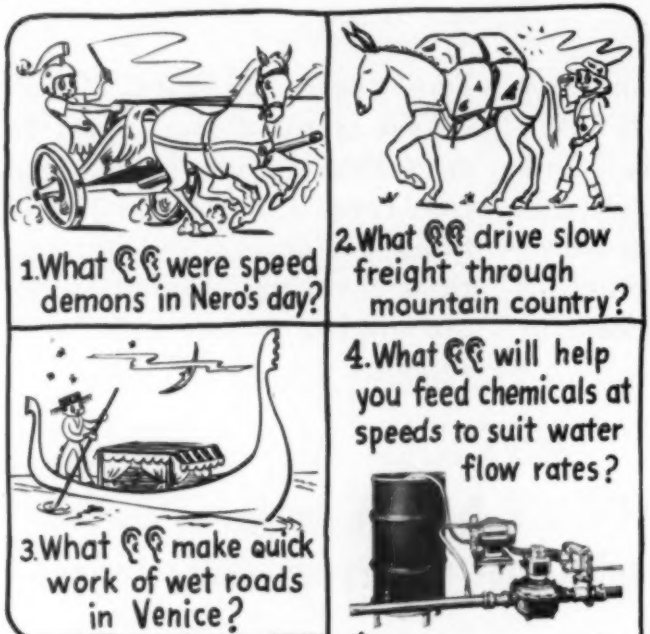
Unlike one HST, Key West's most famous vacationer, I have no particular desire to return there for a vacation—but then there is little on which HST and I agree—. I must say, though, that the drive over the keys was, in the vernacular, "really something." That night we were back in Lake Worth—and there we stayed for two weeks while my girl-Va. battled a virus infection.

I'd like to tell you some of my other impressions of that part of the country, and perhaps I shall one day, but right now I must get my new consulting and technical editing service under way—or didn't you read about it in the September issue?

V.T.Y.—Doc.

"Can Fish Hear?"

Fish can not actually hear sounds. They are affected only by sounds which create *vibrations* in the water. Therefore fishermen can talk as much as they like as far as the fish are concerned.


1. What ¢¢ were speed demons in Nero's day?
2. What ¢¢ drive slow freight through mountain country?
3. What ¢¢ make quick work of wet roads in Venice?
4. What ¢¢ will help you feed chemicals at speeds to suit water flow rates?
Answer:
%PROPORTION¢¢%

If your water flows are likely to vary from a mule's pace to express rates, chances are you need %Proportioneers% Automatic and Proportional Chem-O-Feeder. This system is 100% hydraulically operated . . . requires no electricity or other power supply. With it you can feed hypochlorites at rates from 0-5 g.p.h., pressures from 10 to 125 psi. in strict proportion to the flow through the pipeline.

This is just one of the many types of water treating and purifying systems which %Proportioneers, Inc.% offers you. Mail coupon or write today for data and recommendations.

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4. % PROPORTIONEERS, INC. %

Blucher Poole Feted Service at State San. Engr.

B. A. Poole, Chief Sanitary Engr. of the Indiana State Health Dept., was tendered a surprise luncheon on the 20th anniversary of his service to the State Health Department.

Amongst the forty executives and associates who attended the luncheon were the Governor of Indiana, H. F. Stricker; the State Auditor, F. T. Millis, and the Mayor of Indianapolis, P. L. Bayt.

Silicofluoride Price Ceiling Changes Announced

Should Stimulate Production

Effective August 28, 1951, price ceilings on sodium silicofluoride were increased by the Office of Price Stabilization, which in its order of August 24, 1951, stated: "This increase is allowed in order to stimulate production of sodium silicofluoride, which is in demand for the fluoridation of water to arrest decay of children's teeth—and should go far towards relieving the present fluoride shortage."

The new ceilings are:

Quantities	Prices/lb.* (1)	(2)	(3)
Carload or truckload lots	$0.070	.074	.084
In (c) or (t) lots	.075	.079	.089

*All prices f.o.b. shipping point.
(1) In 100 lb. paper bags.
(2) In barrels of 350 lbs. approx.
(3) In drums of 125 lbs. approx.

The old ceilings of major producers in the Genl. Ceiling Price Regulations ranged between 5 and 6 cents per pound in car lots of 100 lb. paper bags. Some manufacturers, whose ceiling prices under the G.C.P.R. are at present higher than the new specified prices, may continue to price under their existing G.C.P.R. ceilings.

CLARK METER BOX COVERS
For Concrete and Tile

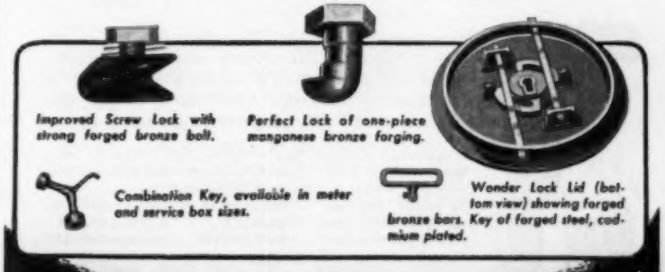
Complete, Economical Protection

Above, A-2-13 Clark Meter Box Cover with screw lock. Height 4" lid opening 13"

Left, A-2-11 Clark Single Lid Meter Box Cover, 4" throat. Also available in 6" and 9" throat.

Right, B-2-11-L Clark Double Lid Meter Box Cover, 6" throat. Also available in 4" and 9" throat.

The many types and sizes of Clark Meter Box Covers permit easy selection for any particular use. Careful design and rigid manufacturing processes assure permanence and protection against replacements. Standard Clark Covers withstand periodic load tests of 11,200 to 13,500 pounds, while extra heavy types withstand 21,400 pounds. All Clark Covers give complete protection to the meter. Available in sizes to fit 15" to 24" drums. Wonder Lock and screw lock covers available in 4" throat only.



Improved Screw Lock with strong forged bronze bolt.

Perfect Lock of one-piece manganese bronze forging.

Combination Key, available in meter and service box sizes.

Wonder Lock Lid (bottom view) showing forged bronze bars. Key of forged steel, cadmium plated.

write

H. W. CLARK CO.
MATTOON, ILLINOIS

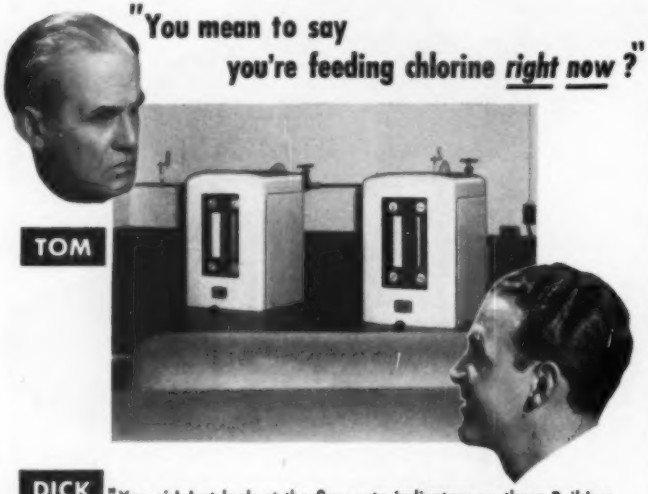
This revision of price ceilings on sodium silicofluoride came about as the result of the fact that manufacturers were not willing to offer this chemical under the old price ceiling and water utilities were finding it impossible to obtain adequate bidding on sodium silicofluoride in the quantities required in fluoridation programs.

New Hampshire Now in New England Pollution Compact

Following the recent action of Vermont, New Hampshire has ratified the New England Water Pollution Control Compact. The New Hampshire Water Pollution Commission ratified on July 30, 1951, and Governor Adams appointed the five N.H. Commissioners on August 21st, one being Wm. A. Healy, Director of the Div. of Sanitary Engineering, State Dept. of Health.

The compact now includes seven states—Mass., Conn., Rhode Island, N.Y., Vermont and New Hampshire. Maine is the single New England state which has not yet ratified the N.E.I.W.P.C. Compact.

As the result of the signing of the Compact by the seventh state, Jo. Knox, Secretary of N.E.I.W.P.C.C. and also Secretary of N.E.W.W.A., was seen all smiles at the recent annual convention of the N.E.W.W.A. in Boston.


"You mean to say you're feeding chlorine right now?"
TOM
DICK "Yes, sir! Just look at the flow rate indicators on these Builders Chlorinizers. When they show a chlorine flow, you can be sure chlorine actually is being fed. Incidentally, why do you ask?"
TOM "Well, I always thought chlorine odors and corrosive fumes were a necessary evil in any chlorinator room. How come I don't smell chlorine in here?"
DICK "We've discovered that Builders Chlorinizers never give off chlorine odors in operation. You see, fresh water is continuously supplied to the tray, drawn into the injector with the chlorine gas, and delivered to the point of application. You can't get tray-produced odors with Chlorinizers in your plant!"
FOR ANY CAPACITY FOR ANY CHLORINATION SERVICE
If you're like Doubting Tom, now's the time to find out more about Builders Visible Flow Chlorinizers. Available in three volumetric models . . . for any chlorination service:
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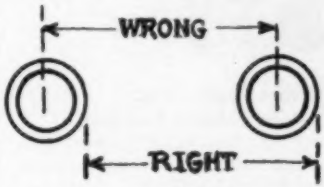
For Bulletins, address Builders-Providence, Inc. (Division of Builders Iron Foundry), 350 Harris Ave., Providence 1, Rhode Island.
BUILDERS PROVIDENCE
Instruments

Measuring Center to Center*

An Easy and Accurate Method

Time and again this writer has seen mechanics measure center-to-center in the *wrong* way, as indicated in the accompanying sketch. If the distance is 8 inches, center-to-center of two pipes, for example, the exact center of each pipe will be laboriously located, and then the distance center-to-center will be measured in the manner as labelled "wrong" in the sketch.



Give the matter a moment's thought and you will see that the right way is to measure from side to side as indicated by the word "Right." The distance is precisely the same as the center-to-center distance, and it is much more easily and accurately measured.

To be sure, if the pipes, rods, pulleys, sheaves, etc., are of different diameter, then this method does not hold. The best way, then, is to do some figuring. Even then the center-to-center method, marked "Wrong," is more difficult than the "Right" method.

*A contribution of W. F. Schaphorst, M.E., Newark, N.J.

Excerpts from Purdue's Sanitary Engineering News*

How water pollution adds to purification costs—A. R. Todd at Wheeling, W.Va., estimates that out of every dollar spent for purification chemicals, 33.7 cents go for chemicals to remove domestic-sewage pollution, and 43.1 cents go toward taking care of industrial wastes.

Elimination of the present dumping of about 120,000,000 gallons of raw sewage along the Brooklyn, N. Y. waterfront from 42nd to 92nd Streets will be achieved by the Owls Head Pollution Control Project.

While in Beaver Dam, Wis., I saw some trickling filter flies that are im-

*Edited by Prof. Don E. Bloodgood.

mune to DDT. I couldn't believe it so I made a test with DDT and I am satisfied that a resistant strain of flies can be developed.

Those tempted to plant the four-pronged seeds of the waterchestnut in their nearby lakes and streams have been warned against such action by the U. S. Fish and Wildlife Service. Despite the fact that the water plant which covers the surface with its green rosettes is rather attractive at first, it soon chokes out all other vegetation. Further, it also prevents the sunlight from growing microscopic fish foods and its spread prevents navigation.

The great Mesabi iron range along Lake Superior is believed by some to be the deposits from the iron bacteria Leptothrix.

One-half of the people in the world went to bed hungry last night, will go to bed hungry tomorrow night, and every night "for the rest of their lives." This is the dramatic language in which the following paragraph is often stated, "Only one-third of the world's people get enough of the right kind of food, and they consume three-fourths of the world's food supply."

There are 574 cities in the United States who have set up civil service systems.

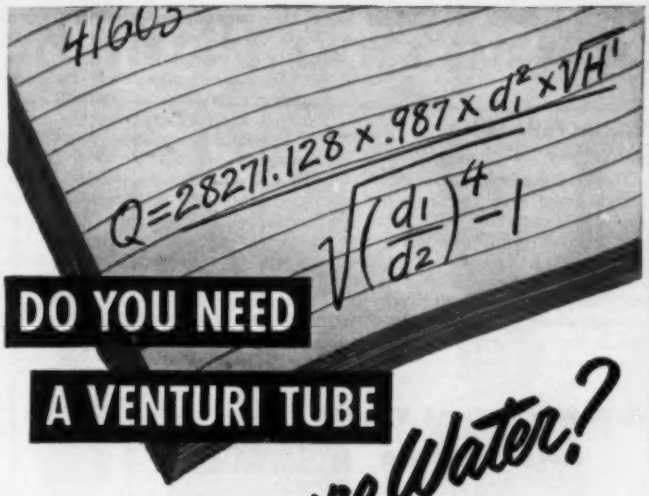
Life expectancy in 1900 was 52 years, in 1950 it is 67 years.

The Indiana State Board of Health Laboratory cotton plugs, used for bacteriological tube plugs, have been replaced by aluminum caps.

MONTHLY WAGES OF MUNICIPAL WATER WORKS EMPLOYEES, 1949

Classification	Population of City		
	Over 100,000	25,000-100,000	10,000-25,000
	Avg	Avg	Avg
Superintendents	550	396	291
Cashiers	135	177	169
Junior stenographers	150	151	153
Storekeepers	235	225	165
Meter readers	175	198	175
Meter repairmen	190	196	157
Light-truck drivers	194	166	158
Laborers (hourly rate)	0.85	0.77	0.66

"In the rayon industry, the iron content should be less than 0.1 and preferably below 0.05 ppm. Iron is responsible for spots and discoloration in tanning or processing hides and leather goods. In the distilling industry, the water must have complete clarity, palatability and freedom from iron and manganese. These are but a few of the many rigid demands



DO YOU NEED A VENTURI TUBE to measure Water?

1. An 18'-6" diameter bronze main belt and a 12'-0" diameter bronze throat belt for use in a concrete Venturi Tube.

2. 72" diameter plate steel reverse flow Venturi Tube.

3. 96" diameter Venturi Tube with plate steel upstream and recovery sections, cast iron throat section.

4. A 60" diameter all bronze Venturi nozzle.

IT'S SIMPLEX IT'S ACCURATE

SIMPLEX makes Venturi tubes for measuring tremendous volumes of water flowing through large diameter pipelines. They include a variety of designs and sizes to suit specific conditions such as those relating to pressure, volume, and space limitations.

Write, stating your particular needs, to Simplex Valve & Meter Company, Dept. 10, 6743 Upland St., Philadelphia 42, Pennsylvania.

SIMPLEX

VALVE AND METER COMPANY

made by industry which must be acknowledged and satisfied by producers of water, whether private or municipal."

Pollution Patterns In Ohio River

The Ohio River Valley Water Sanitation Commission has released a report on "POLLUTION PATTERNS IN THE OHIO RIVER." Among the findings are that, "Freshets caused by heavy rains in the Ohio River Valley accentuate health hazards from sewage pollution. Bacteria from these human wastes are carried downstream to the water supplies of other cities at high flows faster that 'the bugs' die off in the stream."

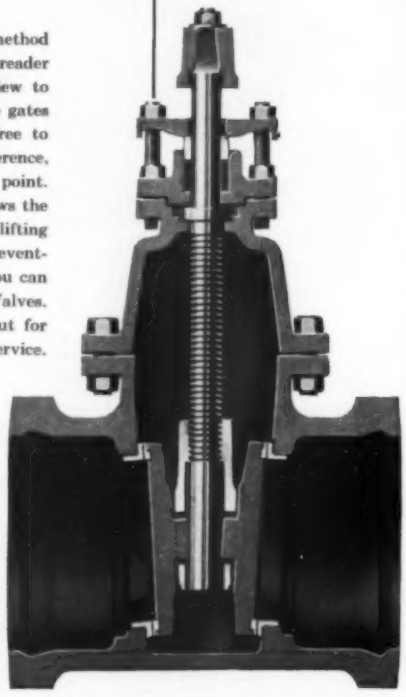
This report forms part of the Commission's program to establish baselines from which pollution-abatement progress can be measured. In addition, the most polluted stretches of the Ohio River are being charted. Intensified action will be focused on these highly polluted stretches. The report includes hydrometric, chemical and mineral studies as well as the bacteriological findings. Copies may be obtained from E. J. Cleary, Exec. Dir. and Ch. Engr., ORSANCO, 414 Walnut St., Cincinnati, Ohio.

R. D. WOOD GATE VALVES

DESIGNED FOR LONG LIFE

DOWN TO THE LAST DETAIL

Even a small point like the method of hanging the gates on the spreader has been studied with a view to eliminating undue wear. The gates or discs are hung *loosely*—free to rotate their complete circumference, preventing wear at any one point. The spreader design withdraws the discs from their seats before lifting them into the bonnet, thus preventing dragging of the faces. You can rely on R. D. Wood Gate Valves. They are designed throughout for generations of uninterrupted service.



BE EXTRA SAFE . . . OPERATE ALL VALVES AT LEAST ONCE A YEAR

Only three moving parts—spreader and two discs. In opening, gates rise clear of valve openings, provide unobstructed passage. Seasoned castings. Rigidly inspected. For working pressure up to 175 lbs. Tested to 300 lbs. Conforming to AWWA specifications. Supplied with bell, flanged or mechanical joint pipe connections.

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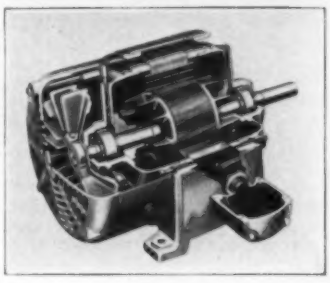
Public Ledger Building, Independence Square

Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

Manufacturers & Equipment News



Explosion-Proof Motor

[001]

U. S. Electrical Motors, Inc., Los Angeles, Calif., has announced the development of a totally-enclosed motor for explosion-proof requirements.

Made in capacities from 3 to 75 hp, Types SE and SES, carries the Underwriters' label in Class I, Group D, for highly inflammable gases and volatile liquids, and in Class II, Groups F and G, for combustible dusts.

Features incorporated in the motors include: Sealed terminal, elongated spark-arresting bearing sleeves, streamlined housing, hi-draft ventilation, removable cover, split hub fan, normalized castings, Lubriflush bearings, asbestos-protected windings, and solid, centricast rotor.

Worthington Makes Gerbereux Mgr. Centrifugal Sales

Worthington Pump and Machinery Corp., Harrison, New Jersey, has appointed Mr. V. de P. Gerbereux manager of the Centrifugal Pump Sales Division. He succeeds Mr. A. H. Borchardt who was recently elected vice president in charge of centrifugal, reciprocating and vertical turbine pump sales.

Mr. Gerbereux was graduated from Cornell University with a mechanical engineering degree in 1924 and the same year took the Worthington Student Training Course. He became successively a centrifugal

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

pump designer, an application engineer and in 1937 assistant manager of the Centrifugal Pump Sales Division.

Inventor of a specific speed slide rule and an acid valve, he is also well known as the author of the centrifugal pump section of Kents Handbook.

S. W. Kitson of Worthington Dies

Sydney William Kitson, 53, manager of the Public Works Division of Worthington Pump and Machinery Corporation, Harrison, New Jersey, passed away on Tuesday, August 28, 1951, in the Deaconess Hospital, Boston, Mass.

Mr. Kitson was a graduate of Massachusetts Institute of Technology, and had been associated with Worthington for the past thirty years. He was a lieutenant in World War I, and a member of the F.&A.M. Century Lodge of East Orange, New Jersey; New Jersey Consistory S.P.R.S., Valley of Jersey City; Salaam Temple of Newark, N.J.; Essex County Shrine Club of Newark; American Legion Post 80 of Maplewood, New Jersey. He also was a member of the National Society of Professional Engineers, and the American Water Works Association.

Hydraulic Dragshovel for Water and Sewer Trenching

1002

Bucyrus-Erie Company, South Milwaukee, Wis., has announced the "Hydrohoe," a completely hydraulic truck mounted dragshovel.

KENNEDY A.W.W.A. GATE VALVES

JOB-FITTED

...for a wide range of water works requirements

KENNEDY Fig. 56, A.W.W.A. Standard Double-Disc Gate Valve.

Every KENNEDY A.W.W.A. valve is JOB-FITTED...specially designed and engineered for the job it has to do. Conforming to A.W.W.A. standards in every detail, these Kennedy valves offer many extra-value features . . . one being the iron itself, which is 50% stronger than ordinary cast-iron . . . to keep them on the job year in and year out.

KENNEDY manufactures a most complete line of water works valves . . . in sizes from 2" to 60" . . . non-rising stem and outside-screw-and-yoke types . . . with a wide variety of gearing arrangements, controls, accessories and end connections available.

Standardize your community on KENNEDY valves . . . and fire hydrants . . . and you get dependable, trouble-free service that means greater economy and protection for decades ahead!

WRITE FOR BULLETIN 106

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

Est. 1877

VALVES • PIPE FITTINGS • FIRE HYDRANTS

This unit has special exclusive features, according to the manufacturer, which make trenching and other specialized digging faster and easier. These include two separate digging actions; precision control permitting fraction-of-inch movements; hydraulic ejector on dipper; no bails, sheave blocks or drag ropes on the bucket to interfere with loading; and rapid conversion to clamshell or crane in the field.

Force for the machine's primary digging action is applied by a hydraulic ram located between the boom and the dipper handle. A second, separate and distinct digging motion comes from the telescoping of the boom. By hydraulically extending and retracting the boom, the operator reportedly makes a level, scallop-free cut, digs across pipe and buried cable, excavates in front of and behind boulders to roll them free —all without moving the machine an inch. The manufacturer reports that test data indicates this telescoping feature saves up to 40 percent of time usually lost in moving up.

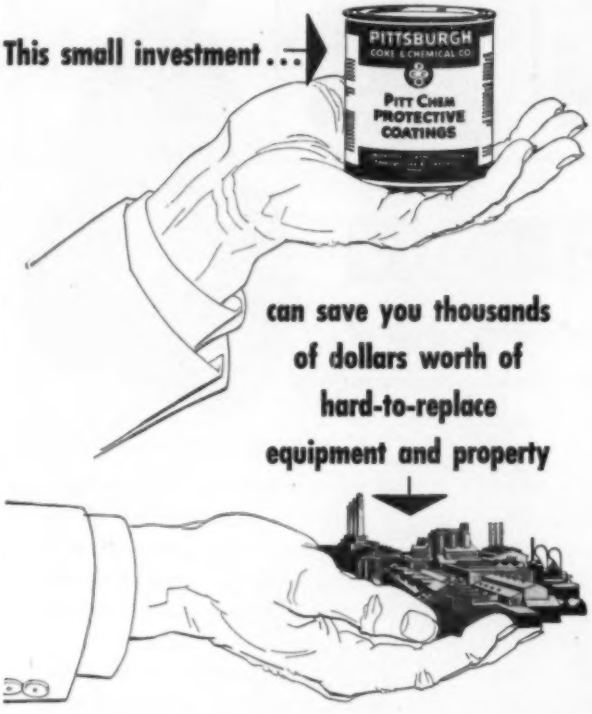
On open highways this speedy machine, with its telescoping boom and precise hydraulic control, is capable of traveling at speeds up to 50 mph.

Norcam System of Rehabilitating Sewers Used in Flooded Cities

Smith & Loveless Norcam of Kansas City, Mo., franchise holder for the Norcam Sewer Cleaning Process in the Central United States, have been awarded contracts for removing debris deposited by recent floods in the sewer mains of Manhattan, Topeka, Lawrence, and Hays, Kansas. Participating in this sizeable undertaking is Southwest Norcam of Dallas, Texas.

One of the largest single sewer cleaning jobs ever undertaken will be that for the City of Topeka, where approximately 450,000 feet of mains are to be cleaned, varying in size from 6" to 108". This work is to be completed in 90 days, according to terms of the contract, and Southwest Norcam has been called in to participate in the job of rapid rehabilitation.

The Norcam process of sewer cleaning was invented and patented by N. M. Redmond of the New Orleans Sewerage and Water Board. Mr. Redmond licensed Southwestern Norcam of Dallas, Texas, to use the Norcam process in the Southwest in early 1949. During the past two years this firm has cleaned mains on a guaranteed basis for many cities and industries in the Southwest.



Pitt Chem Protective Coatings guard your equipment with a tough, surface-protecting film . . . an impervious sheath against strong chemicals, high temperatures, atmospheric exposure and other destructive elements of industrial corrosion and contamination. *Pitt Chem* Coatings are completely uniform and dependable because they are laboratory-controlled from raw materials to finished product. You'll find the cost of safeguarding your equipment with *Pitt Chem* is surprisingly low. ● For more information, write for new booklet, "Control Corrosion Through Pitt Chem Protective Coatings."

★ Hot Applied Tar Base Coatings
★ Cold Applied Tar Base Coatings
★ Alkyd Base Coatings
★ Chlorinated Rubber Base Coatings
★ Vinyl Base Coatings
★ Phenolic Base Coatings

W&S 3726

Protective Coatings Division
PITTSBURGH
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GRANT BUILDING · PITTSBURGH 19, Pa.

COKE • CEMENT • PIG IRON • COAL CHEMICALS • ACTIVATED CARBON • AGRICULTURAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS

Pump Controller Protects Wells from Sea Water Seepage

1003

Foxboro Company, Foxboro, Mass., through the installation of a Foxboro Rotax Flow Controller, has protected the well water at the Prov-

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

incetown pumping station in North Truro, Mass. against the dangers of contamination by sea water. The special system of pump flow control is based on inflow to the wells, rather than pressure in the mains and instrumentation consists primarily of a Foxboro Rotax Flow Controller which regulates pumping in accordance with the inflow.

Located on the tip of Cape Cod, the Provincetown wells are subject to seepage of sea water or clogging of gravel pits if pumped at an excessive rate. Pressure-controlled systems are not suitable as they call for high-volume pumping during periods of great demand. The Foxboro Flow Controller assures a rate of withdrawal which never exceeds inflow to the wells, and the flow rate is adjustable at will up to the established maximum.

W. H. Brown

R. L. Lauderdale

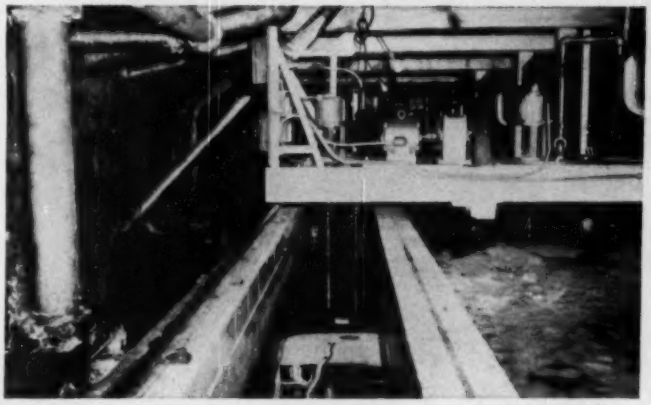
Changes at Builders-Providence

R. L. Lauderdale to Builders-Pacific; W. H. Brown, Applications Engineer

Richard L. Lauderdale, sales engineer of Builders-Providence, Inc., has joined the engineering sales staff of Builders-Pacific, Inc., Berkeley, California. Lauderdale, a graduate of the Univ. of Okla., and a member of the Am. Soc. Civ. Engr., has been specializing in Chlorinizer sales engineering.

Walter H. Brown has been transferred to the Projects Dept. of Builders-Prividence, Inc., and will specialize in equipment applications for sewage and industrial waste treatment. Previously he was a sales engineer in Builders' Standard and Engineered Products Dept. A graduate of Brown University, Brown is Secy.-Treas. of the Providence Section, Am. Soc. Mech. Engrs., a past president of the New England Sew. Wks. Assn., and a member of the Board of Control of the Federation of Sew. & Ind. Water Assns. Mr. Brown is a licensed professional engineer in Rhode Island. He was Supt. of Sewage Treatment for the City of Cranston, R. I. from 1942-49.

ABW FILTER REMOVES SUSPENDED SOLIDS IN Sewage and Trade-Waste Effluents



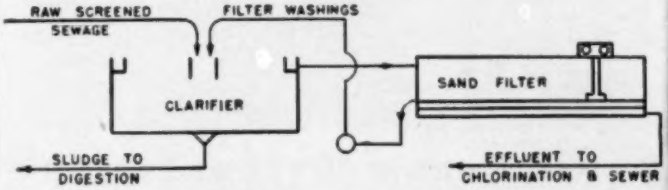
Typical trade waste installation of Hardinge Automatic Backwash Sand Filter

In the sewage treatment field, the use of the Hardinge ABW filter is attractive on sewage projects where a high removal of suspended solids is desirable but a high removal of B. O. D. is not necessary and ample dilution for the effluent is available. Preceded by a clarifier, operating on a 1½ to 2 hour retention period, the filter can remove 75 to 80% of the suspended solids not readily removed by sedimentation.

If chemicals are added, a suspended solids removal of 90% and B. O. D. removal of 60% can be obtained.

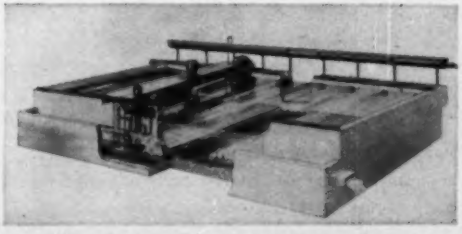
It may also be used to advantage on the effluents from final settling tanks in sprinkling filter and activated sludge sewage plants when a very high removal of suspended matter is required.

The use of the filter alone or in combination with a presettling tank appears advantageous on a large variety of industrial wastes.



Flow sheet for sewage or trade waste hook-up

No shut-down or "change-over" is necessary to backwash the Hardinge filter bed. It's all done automatically—a section at a time, without interfering with the normal filter operation. Write for Bulletin 46-15.



HARDINGE COMPANY, INCORPORATED

YORK, PENNSYLVANIA—240 Arch St. Main Office and Works

NEW YORK 17 • SAN FRANCISCO 11 • CHICAGO 6 • HIBBING, MINN. • TORONTO 1

122 E. 42nd St. 24 California St. 205 W. Wacker Dr. 2016 First Ave. 200 Bay St.

Neptune Meter Appoints Smith

Neptune Meter Company, New York, N.Y., announces the appointment of Mr. Wentworth Smith as General Sales Manager.

Mr. Smith is a graduate of Williams College and attended Yale Graduate School. Before coming with Neptune, he was with the sales staff of Safety Car Heating and Lighting Company.

In 1950, Mr. Smith was appointed Assistant General Sales Manager, prior to which time he was engaged in special market studies.

General Purpose Pumps

1004

Economy Pumps, Inc., Division of Hamilton-Thomas Corp., Hamilton, Ohio, has announced a new line of general purpose centrifugal pumps. Designated as Type SCC, the new pumps are light in weight, easy to handle and install.

The pumps are of close coupled type, equipped with mechanical seals, and motors are of the standard open drip type. Standard mounting is vertical; however with the addition of motor feet, the pumps can readily be adapted for horizontal mounting.

Standard pumps are bronze fitted with casing and motor stand of close-grained, high quality cast iron. Impellers and wearing rings are of hard bronze. Impellers are dynamically balanced and hand fitted.

Two sizes are currently available; 2 inch suction x 1¼ inch discharge and 1½ x ¾ inches. Both operate at 345 rpm and capacities range to 100 gpm at heads to 120 feet.

Municipal Service Promotes Bailey

Municipal Service Company, Kansas City, Missouri, has announced the promotion of E. Allen Bailey to the position of Chicago District Manager.

Mr. Bailey is a graduate of Cornell University and has served with the firm in various capacities, including those of field and sales engineering. He will be in charge of the territory comprising Wisconsin, Minnesota, Iowa, Illinois, Indiana, Ohio and Michigan. Chicago headquarters is in the Engineering Building, 205 West Wacker Drive.

Promotions at Atlas Mineral Products

George L. Wirtz, President of the Atlas Mineral Products Company, Mertztown, Penn., has announced the following promotions and appointments:

Edison C. Sickman, formerly Sales Coordinator, has been appointed General Sales Manager.

Donald F. Deakin and Gerald F. Gilbert, Jr., will assist Sickman in sales department activities.

Earl A. Erich has been appointed to handle Technical Service activities.

Augustus Boova, a graduate of St. Vincent College and formerly with Ciba Products Co., has joined the company as a sales trainee.

George Gabriel, Engineering Coordinator, has assumed the additional duties of Plant Manager and George Kanelis has been promoted to Assistant Plant Manager along with Raymond Trollinger who became Plant Superintendent.

Don't Burn or Bury Your Sludge...

Process it with a ROYER and SELL it!

Sewage sludge can be processed into a readily saleable fertilizer at a cost less than that of burning or burying it... with a Royer Sludge Disintegrator. Just shovel the sludge direct from the drying beds into the hopper and the Royer shreds, removes trash, reduces moisture content, aerates and discharges the finished product direct to bag, pile or truck.

Because it is rich in nitrogen, phosphoric acid and potash, fertilizer from sludge is in constant demand by florists, nurserymen and golf clubs everywhere. Convert an item of expense into one of income... with a Royer.

Send for a copy of the "Sewage Sludge Datalog"... it contains much of interest to sewage plant operators.

ROYER

PIONEERS IN THE SALVAGE OF SEWAGE SLUDGE

ROYER FOUNDRY & MACHINE CO.

170 PRINGLE ST., KINGSTON, PA.

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

Chlorinator Cleaner

1005

Lake Products Company, Inc., St. Louis, Mo., has developed a new chlorinator cleaner called "C-L-Two."

According to the manufacturer the cleaner will quickly and easily remove chlorine-hydrate, gum, and wax accumulations from bell jars, float, tray, needle valve, metering tube, gas delivery tube, etc.

The cleaner is described as safe and non-injurious to all parts of any make chlorinator and will maintain top capacity for all makes of chlorinators.

Detroit Officials Witness Testing of Worthington Pumps

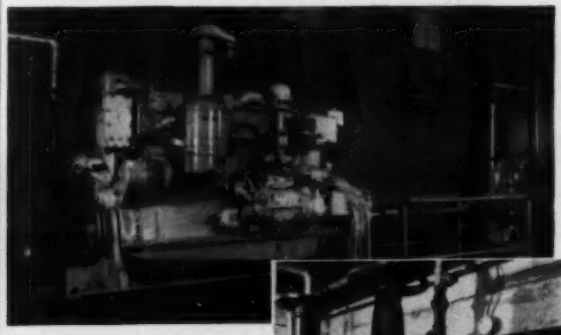
Witnessing a test of a 12-inch model pump at Worthington Pump and Machinery Corporation, Harrison, N.J., are three Detroit officials. In the above photograph, from left to right, are Mr. W. C. Rudd, mechanical engineer, recording gauge readings as Mr. M. F. Wagnitz, assistant city engineer, Mr. C. Schmidt, Worthington test engineer, and Mr. G. C. Richards, superintendent of the Department of Public Works for Detroit make observations.

The model pump, being tested, is homologous to the four 72 inch vertical pumping units being supplied by Worthington for the City of Detroit's new Freud Pumping Station, Detroit, Michigan.

Each pump is capable of delivering 190,000 gallons of water per minute when pumping against a static head of 45 feet. The pumps are driven by 3,000 hp, 225 rpm vertical motors supplied by the Electric Machinery Manufacturing Company, Minneapolis, Minn.

NEW CONSTANT FLOW

Pump Control Safeguards Wells at Lower Cost



Pumping Station has Caterpillar D13000 Diesel engine driving 7 stage Worthington turbine pump. Whitman & Howard, consulting engineers.

Foxboro Recording Rotax Flow Controller electrically regulates throttle of Diesel engine to maintain constant rate of water flow.

At the Provincetown Pumping Station in Truro, Mass., a new fully automatic Foxboro pumping control system has solved a long-standing problem. Supplied by slow-flowing wells near the ocean, this station requires heavy pumping where over-drawing would permit seepage of brine into the wells.

Employing a Foxboro Rotax Flow Controller to operate a throttle control on the CATERPILLAR DIESEL pumping engine, this all-electric control system automatically maintains constant flow from the pump, without the attention of an operator. It affords important fuel savings because engine speed is automatically varied to compensate for pressure changes in the main.

For many inland pumping stations also, this new Foxboro Constant-Flow Pumping Control offers maximum safe withdrawal from slow-flowing wells, with complete protection against clogging the gravel pack with sand. Write for full details. **The Foxboro Company, 22810 Neponset Ave., Foxboro, Mass., U.S.A.**

FOXBORO Instrumentation

INDICATING · RECORDING · CONTROLLING

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

Mathieson Develops New Method for Chlorinating Water

1006

Mathieson Chemical Corp., Baltimore, Md., has developed a new method for chlorinating water, wherein a unique product-equipment combination is employed.

The new product is Mathieson's well-known HTH (high test calcium hypochlorite) in tablet form. The equipment is a specially engineered feeder called a Hypochlorinator, designed to dissolve the tablets and dispense the resultant available chlorine solution at rates which can be accurately controlled and quickly varied to cover a wide range of operating demands.

According to Mathieson, the new HTH-Hypochlorinator combination will eliminate the disposing of insoluble sludge and the clogging up of equipment, handling and storing bulky heavy glass bottles of sodium hypochlorite; and all weighing, mixing and handling operations.

The tablets are pure compacted HTH, containing 70% available chlorine with no binder or filler, and possessing excellent mechanical stability. They are ¾ of an inch in diameter and ¼ of an inch thick, with slightly curved faces to facilitate handling. Each tablet weighs about one-sixth of an ounce, equivalent to about one teaspoonful of the granular HTH. They sell at approximately the same price as the granular HTH and come packed in 100 lb. non-returnable drums.

The Hypochlorinator takes water from high pressure point of a system at a rate controlled by a needle valve and indicated by a flow meter. The water is injected through the tablet bed, resulting in a hypochlorite solution which is returned to the system at a low pressure point. Since the body of the unit is of transparent plastic, the operator can tell at a glance when jar refilling is necessary.

Atlas Mineral Appoints Evans

Atlas Mineral Products Co., Mertztown, Pa., has announced the appointment of Robert C. Evans as executive assistant to Kenneth T. Snyder, General Manager of the Western Division, whose headquarters are at Houston, Texas. Evans is a graduate of Baylor University and was formerly associated with the Sheffield Steel Corporation.

Diamond Alkali to Expand Painesville Plant

Diamond Alkali Company, Cleveland, Ohio, has announced a two-year, multi-million-dollar program of plant expansion at the Painesville, Ohio, Plant.

Mr. Raymond F. Evans, president of the company, stated that the project embraces extensive enlargement and modernization of present facilities which will enable the company to step-up output of chlorine and caustic soda substantially by the electrolytic method.

The expansion-modernization program is expected to require two years to complete.

High Intensity Spotlight

1007

Stonco Electric Products Co., Elizabeth, N.J., has developed a powerful, new outdoor spotlight providing 100,000 candlepower with only a 300-watt rating.

The new unit is designed to concentrate its entire light output in a long-throw, oval-shaped, narrow floodlighting beam that is recommended for area protection lighting.

Made of non-corrosive, heavy-duty cast aluminum throughout, the Stonco No. 56 spotlight has a universally adjustable cast-aluminum

(Continued on page 111A)

For large valves and frequently used valves, operating costs often are reduced and efficiency increased by remote control. In emergencies, quick operation of distant valves may be an extremely vital matter.

M & H Valves are furnished both for manual or remote control. M & H Hydraulic Valves have either Cast Iron Brass-Lined or Skeleton Type Brass cylinders, and are furnished with or without square bottom. Also electric motor operators can be adapted to M & H Valves.

M & H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

OTHER M & H PRODUCTS

COMPLETE INFORMATION ON REQUEST

FIRE HYDRANTS
TAPPING VALVES AND SLEEVES
SHEAR GATES
CHECK VALVES
MUD VALVES
FLAP VALVES
FLOOR STANDS

M&H PRODUCTS Everywhere

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(Continued from page 110A)

swivel arm threaded ½ inch NPT to fit a variety of standard interchangeable accessories such as flat base, weatherproof junction boxes, wall brackets, wiring troughs, etc.

Dow Chemical Elects Putnam

Dow Chemical Company, Midland, Mich., has announced the election of Dr. Mark E. Putnam to the newly created position of executive vice-president.

Dr. Putnam, whose service with Dow dates back to 1915, has been a director since 1941 and a vice-president since 1942.

Graver Water Conditioning Co. New Appointments

Graver Water Conditioning Co., has announced appointment of Harold R. Fosnot as Eastern Sales Manager with headquarters at the Company's home office, 216 West 14th Street, New York.

Mr. Fosnot, who has been with Graver since 1935, is a licensed Professional Engineer in the State of Illinois; and since 1937, was the Graver Chicago District Manager, where he worked extensively in the industrial and municipal water treatment field.

Replacing Mr. Fosnot as the Graver Chicago District Manager, will be Herman M. Ross, who had previously been the Cleveland District Manager.

In Cleveland, Graver will now be represented by Richard E. Lewis, who was previously in the Graver home office at New York, handling all phases of water treatment. The new headquarters of Mr. Lewis in Cleveland will be in the Hippodrome Building.

Graph Paper of New Design

1008

Orbit Electric Company, Chicago, Ill., has announced the availability of a new Dylewski "Arktan" arctangent coordinate graph paper for use in curve plotting in scientific, mathematical, engineering, and statistical analysis.

"Arktan" Form 1235 has one arctagent scale and one linear scale; and "Arktan" Form 1236 has double arctangent coordinates.

According to the manufacturer the use of arctangent coordinates permits the plotting of uninterrupted curves of data having values ranging from plus infinity to minus infinity and including zero as well. Most asymp-

Quit worrying about "downtime" and do something!

SARAN LINED steel pipe

Many reasons for "downtime" are unpredictable—BUT lost production due to pipe repairs and replacements is very definitely in the realm of your control! Follow the lead of many of the country's leading manufacturers, install dependable saran lined steel pipe—that means long term operation at a minimum maintenance cost.

Consider these advantages: Saran lined steel pipe provides excellent corrosion resistance, high pressure strength, superior rigidity, and its ease of installation requires NO special tools or handling.

These advantages are important to you—now more than ever before, so investigate saran lined steel pipe today. Mail this coupon to the Saran Lined Pipe Company for full information. *Saran lined steel pipe is manufactured by The Dow Chemical Co.*

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product

totic funtions become approximately linear in this coordinate system.

Form 1235 is recommended when on variable approaches a finite limit asymptotically as the other variable approaches infinity. Form 1236, the double arctangent graph paper, is recommended when both variables approach infinity as a limit. Samples are available upon request.

De Laval Completes Building on West Coast

De Laval Steam Turbine Co., Trenton, New Jersey, has announced the completion of a new building at 160 Folsom Street, San Francisco, California.

This building will be De Laval's new San Francisco headquarters for sales and service activities. Besides providing increased warehousing facilities for standard centrifugal pumps, IMO pumps, speed reducers and flexible couplings, it will also permit much faster handling of repair and service orders for De Laval's western customers.

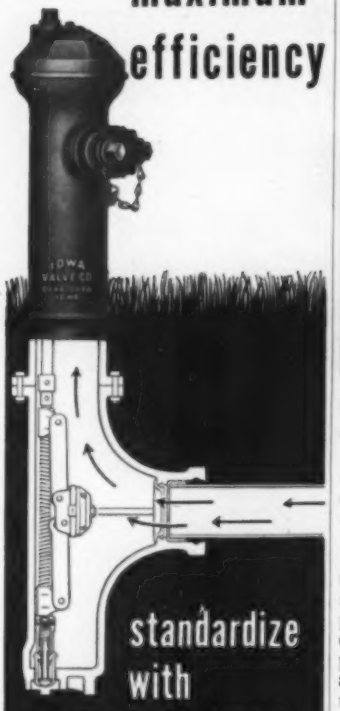
Mr. C. F. Reeves, who has long been in charge of De Laval's West Coast sales will be in charge of this expanded activity.

Rockwell Makes Changes in Coast Sales Force

Rockwell Manufacturing Company, Pittsburgh, Pa., has announced the appointment of Robert B. Kitzmiller as Manager of the San Francisco office. The announcement was made by H. Boezinger, West Coast Sales Manager for the company. Mr. Kitzmiller replaces Gilbert T. Bowman, who was recently transferred to Rockwell headquarters in Pittsburgh.

Kitzmiller joined Rockwell in 1934 and worked in the Production and Sales Order departments of the main office in Pittsburgh. In 1940 he was made Assistant to the Director of Sales, a position he held until 1945 when he was transferred to the Los Angeles office. Shortly thereafter he was assigned to the Seattle territory as a sales engineer. In that time he has sold, and become familiar with,

for maximum efficiency



standardize with IOWA hydrants

Two piece operating nut with special adjustment screw solves the problems of expansion and contraction . . . makes Iowa hydrants easy to operate at all times.

Positive operating mechanical drain valve can be removed along with all other working parts through top of hydrant without special tools.

Fixed position of valve arms makes leaking impossible should standpipe be broken.

Unrestricted water flow gives full pressure at extreme low loss of head.

Built to conform to the latest A.W.W.A. specifications.

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FREE
to WATER WORKS and SEWAGE MEN

HOW TO CONTROL ALGAE

"The Use of Copper Sulphate in Control of Microscopic Organisms" by Dr. Frank E. Hale (former Director of Laboratories, Dept. of Water Supply, City of New York) is an authoritative work concerning the control of micro-organisms and elimination of tastes and odors. Describes in detail methods of controlling various forms of microscopic life commonly encountered in water supply systems. Contains descriptive material, plus 48 photo-micrograph studies of organisms discussed.

ROOT AND FUNGUS CONTROL

"Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains," by John W. Hood, contains information published for the first time. This material includes actual methods for control and operating procedure. Here's the book that is a "must" for all sewage men.

GET EITHER OR BOTH OF THESE BOOKLETS ABSOLUTELY FREE—
These two valuable booklets, so important to all water works and sewage men, are yours *without obligation.* Mail coupon below!

Write Today, Supply Limited!

PHELPS DODGE REFINING CORPORATION
40 Wall Street, New York 5, N. Y.

Please send my free copy of (check one or both):

☐ "Control of Microscopic Organisms"
☐ "Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains"

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Employed by _____
Address _____
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WS-1051

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the complete line of the company's Meter and Valve Division.

Magnetic Stirrer with Teflon-Covered Magnets

1009

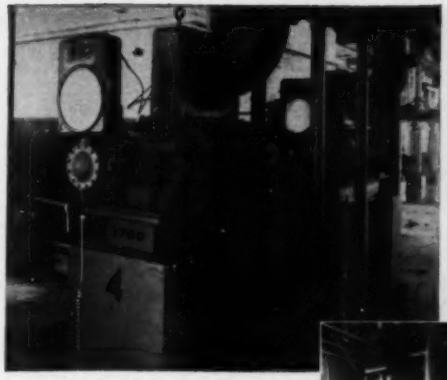
Laboratory Industries, Inc., Chicago, Ill., has developed a new magnetic laboratory stirrer called "Magne-Stir" that incorporates many new and unusual features. Teflon-covered stirring magnets, offered for the first time as an exclusive feature of "Magne-Stir," will not break and are resistant to all acids and alkalis. The powerful motor will stir one liter or more of liquids up to 60% glycerol solution. Speed can be varied from barely turning to vigorous churning action and a separate on-off switch permits stirrer to be turned on or off without disturbing speed setting.

The rugged cast aluminum housing is designed either for use directly on a bench or table, or mounted simply and securely on any part of a set-up frame. Teflon-covered stirring bars are available in three sizes.

Where desired, Pyrex glass covered stirring bars can also be furnished in several sizes.

Josam Appoints Matheis Director of Engr. Dept.

Josam Manufacturing Company, Cleveland, Ohio, has announced the appointment of "Mat" Matheis to the staff of the company. After an absence of a few years, supervising mechanical contracts on large construction projects, Mr. Matheis returns to Josam to head the Engineer-



Part of an installation of nine R-C Meters in a large plant, some of which date back 10 years or more. Capacities range from 3,000 cfh to 130,000 cfh.

YOU CAN ALWAYS

trust

R-C METERS

Continued repeat orders for R-C Positive Displacement Meters indicate the complete confidence of sewage treatment plant operators in the unvarying reliability of these units. Many have been installed so long that the original dates have been forgotten—yet they continue to measure as dependably as the day they were first put into service. That is because:

1. Accuracy is not affected by variations in specific gravity, rate of flow, pulsation, moisture, impurities or uncontrollable factors.
2. Accuracy is not subject to adjustment of meter or recorder by operators or other persons.
3. Accuracy is not affected by reasonable overloads.
4. Accuracy is permanent because measuring chambers are surrounded by precision-machined, cast iron surfaces.

Compactness of R-C Meters permits installation in cramped spaces. Sizes from 4,000 cfh to 1,000,000 cfh provide range for all sewage treatment applications. Indicating and recording devices are available. Ask for details in Bulletin 40-B-14 or write us about your needs.

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510 Mount Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

ing Department under the direction of Joseph Hirshstein, President, and to take charge of product engineering, testing and research, as well as plant expansion, engineering and maintenance.

One-Man Mobile Work Tower

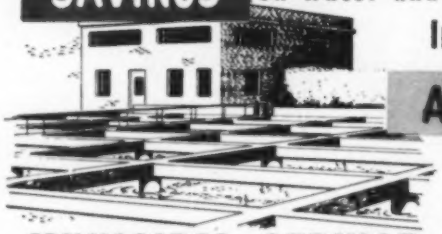
1010

Safway Steel Products, Inc., Milwaukee, Wis., has announced production of the Moto-Lift, the electro-hydraulic work tower that is designed for one-man operations and is self contained. Controlled by a foot operated lever on the platform, the tower is quickly raised to permit reaching equipment or ceilings as high as 22-23 ft. No connection to an electric outlet is required and the telescoping tower is easily rolled anywhere and locked in the working position.

The work platform is elevated through extension of hydraulic ram, with the hydraulic pump operated by a battery-powered electric motor. Any standard 6-volt automotive storage battery may be employed.

Pressing the foot lever in one direction makes an electric contact to elevate the platform—turning it in the opposite direction will release the hydraulic pressure to lower the platform.

GREATER SAVINGS on Water and Sewage Plant Installations ASSURED



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Municipal Service Company specialists can relieve you of complicated technical details involved in the mechanical portion of your project. Our experience is your assurance of a successful plant installation. Write or wire today for details.

You're sure of greater savings when you contract with Municipal Service Company to furnish and install mechanical equipment and piping for your new municipal sewage or water plant. Municipal Service Company is a specialized organization of experienced engineers and skilled craftsman operating on a nation-wide basis.

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Dept. M4—908 Grand Ave., Kansas City, Mo.
Chicago office: 205 West Wacker Drive

Worthington Plans Modernization of Oil City Plant

Worthington Pump and Machinery Corp., Harrison, New Jersey, plans a $500,000 modernization of its Oil City, Pa. plant, according to an announcement by Mr. L. C. Ricketts, vice president in charge of manufacturing. Plans include re-equipping the present foundry and establishing a new electric power supply.

New molding machines, sand conditioning and sand supply equipment will be installed in the plant. Mechanization includes installation of overhead crane service at all working stations and 500 feet of roller conveyors.

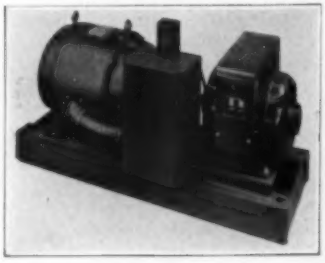
Melting capacity will be increased by installing one new cupola and reconditioning the present one. A mechanical cupola charging system will be provided to automatically feed coke and all raw scrap and pig materials to both cupolas.

A. O. Smith Advances Madden

A. O. Smith Corp., Milwaukee, Wisc., has announced the appointment of John B. Madden as hydraulic sales manager for the North Central District, with offices at 310 S. Michigan Ave., Chicago, Ill.

Mr. Madden, former product supervisor, originally operated hydraulic sales from A. O. Smith's Houston Works, where the firm's vertical turbine pump manufacturing is centered.

The appointment of Mr. Madden, announced by Chicago General Sales Manager William C. Powell, will permit Hal Kern, former district pump sales manager, to give more concentrated attention to distributor accounts in the field.



High Cycle Generator for Electric Hand Tools

1011

Electric Machinery Mfg. Co., Minneapolis, Minn., has announced the availability of a new mono-coil High Frequency Motor Generator Set for

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

converting 60 cycle current to 180 cycle and 360 cycle frequencies.

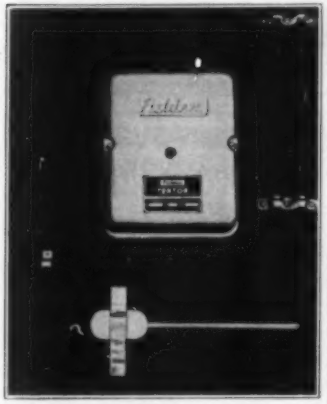
The sets are self exciting and have built-in voltage regulation which automatically compensates for fluctuations in voltage to the load.

G-E Appoints Dunn Manager of Michigan Apparatus District

General Electric Company, Schenectady, New York, has announced the appointment of Clifford M. Dunn as manager of the company's Michigan Apparatus district.

As district manager, Mr. Dunn succeeds Arthur R. Hines, who has been appointed assistant manager of marketing for the company. Mr. Dunn's headquarters will be in Detroit. The district comprises most of the state of Michigan.

Born in Wichita, Kansas, Mr. Dunn is a graduate of Washington University, St. Louis, where he received a degree in electrical engineering. He has been a General Electric Sales representative in the Midwest since 1932.



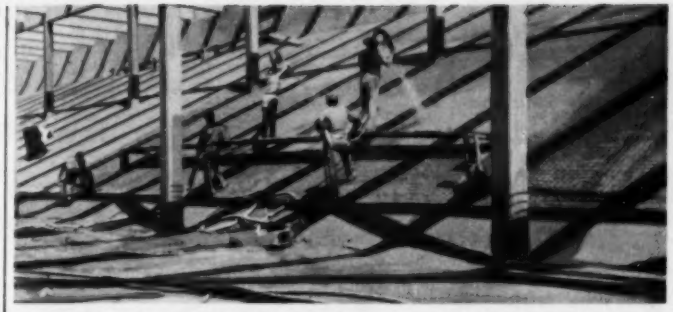
Tektor Level Switch

1012

Fielden Instrument Corporation, Philadelphia, Pa., has announced the availability of the new Tektor Level Switch that makes possible level control of practically all liquids and solids. Liquids may be of high or low viscosity and may have electrical conducting or insulating properties.

No electrical contact is necessary with the material under control and the equipment does not rely on floats, diaphragms, or any moving mechanical parts.

The electrode, connected to the instrument through a two-foot length of cable, consists of a simple probe, 4 to 6 inches long, ¼ to ⅜ inches in diameter, which is inserted into the



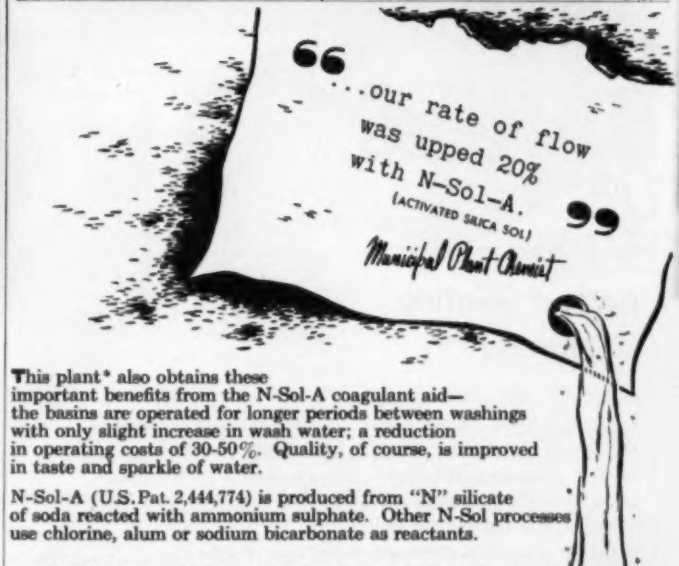
"GUNITE" LINING RESTORES RESERVOIR

When the old, open Ballou Park Reservoir at Danville, Va., was improved and covered in 1948, excessive leakage of the old brick lining was stopped with reinforced "GUNITE." The photo shows details of the process. After concrete columns to support the roof were placed, wire mesh reinforcing was laid and the entire reservoir was "GUNITED."

Note that the reinforcing and "GUNITE" were carried over the column footings and up the columns approximately three feet to prevent leaking at these points.

The use of "GUNITE" for repair and construction of reservoirs, bridges, buildings, etc., is illustrated and described in Bulletin C2400. We shall gladly send a copy at your request. On your letterhead, please.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN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Municipal Plant Chemist
N-SOL PROCESSES FOR WATER COAGULATION

This plant* also obtains these important benefits from the N-Sol-A coagulant aid—the basins are operated for longer periods between washings with only slight increase in wash water; a reduction in operating costs of 30-50%. Quality, of course, is improved in taste and sparkle of water.

N-Sol-A (U.S. Pat. 2,444,774) is produced from "N" silicate of soda reacted with ammonium sulphate. Other N-Sol processes use chlorine, alum or sodium bicarbonate as reactants.

FREE: Send for chart which correlates flow rates and silicate dosages.

*Name on request.

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Manufacturers of Soluble Silicates
1100 Public Ledger Building, Philadelphia 6, Pa.

container at the level at which control is required.

A level differential of 1/32 inch up to 3/8 inches may be obtained.

Leeds & Northrup Advances Machler

Leeds & Northrup Co., Philadelphia, Pa., has announced the appointment of Dr. Raymond C. Machler, as Director of Research and a member of the Executive Committee. Dr. Machler, formerly Associate Director of Research, succeeds I. Melville Stein, who recently was elected to the newly created post of Executive Vice President.

A native of Evanston, Ill., Dr Machler is a graduate of Northwestern University, where he received the degrees of Bachelor of Science, Master of Arts, and Doctor of Philosophy. He joined Leeds & Northrup in 1929 as a research engineer and physicist and became Associate Director of Research in 1948.

Literature & Catalogs

Laboratory Chemicals

1013

J. T. Baker Chemical Co., Phillipsburg, New Jersey, has just published a **Specification catalog of 'Baker Analyzed' Reagents** and other laboratory chemicals.

Pages two through eight of the 257 page catalog picture the steps taken in the manufacture of 'Baker Analyzed' Reagents with the actual lot analysis on each label.

Pages nine through thirteen contain explanatory information on use of the catalog and include an announcement of the new 'Baker Analyzed' label. The succeeding pages present, in concise form, the latest specifications and prices of each chemical.

Commercial Standards For Septic Tanks

1014

Printed copies of **Commercial Standard CS177-51,** covering Bituminous-Coated Metal Septic Tanks (Single Compartment, Residential), are now available, from the Commodity Standards Division of the Office of Industry and Commerce, U. S. Department of Commerce.

The booklet covers thickness of metal, pertinent items of design of two types, minimum capacity, means

(Continued on page 118A)

OMEGA

THE LAST WORD IN FEEDERS . . .

— for alum, lime, soda ash, ferric sulphate, sodium fluoride, carbon, and other water treatment chemicals. For Bulletins and complete information, address Omega Machine Company, (Division of Builders Iron Foundry) 350 Harris Ave., Providence 1, R. I.

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Dependable because they are tough and rugged. Made to withstand the wear and tear of the modern day strain and stress. For generations of incomparable service, only cast iron pipe can qualify. Serving the industry with Super de Lavaud Cast Iron Pipe, centrifugally, in modern lengths.

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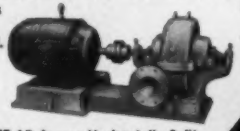
Faithful Performance on Important Jobs

— such as water supply, brine circulation, booster service, white water and overflow, hot well, makeup water, etc., etc.

Capacities to 1,200 G.P.M.

Heads to 460 Ft.



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TYPE-AD Aurora Horizontally Split Case, Back-to-Back Impellers, Two Stage Centrifugal Pump. Particularly suited to clear water and low viscosity liquids not containing solids. *Write for* **BULLETIN 106**

For Every Purpose

APCO TURBINE-TYPE PUMPS are unbeatable on low capacity, high head duties.

We carry popular sizes of Apco Pumps IN STOCK for immediate delivery.

AURORA CENTRIFUGAL PUMPS are available in many types and sizes —all noted for their streamline coordination between impellers and shells.

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DISSOLVED AIR FLOTATION SYSTEMS

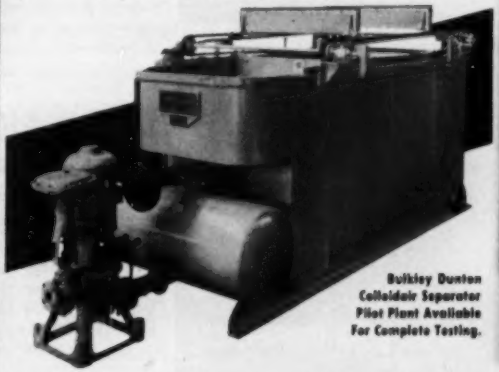
For Your Problem of:

SUSPENDED SOLIDS SEPARATION

A totally new process for high efficiency separation of—**suspended solids • oils and greases • recoverable by-products • industrial wastes** — from process or effluent flows.

Leading industries are utilizing this newest high efficiency-low space requirement method to economically—

- **Recover at a profit former waste materials**
- **Recover water for reuse**
- **Control stream pollution**
- **Augment existing facilities**



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- Carbon separation
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- Petroleum refining
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- Railroad maintenance
- Fruit & vegetable canning
- Automotive industry
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- Glue & gelatin manufacture
- Beet & cane sugar refining
- Fish canning
- Wine distilling

For further information please write

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A Filter Medium For All Purposes

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JOINT LEAKAGE
USE
CARSON CLAMPS
With Pearlitic C.I. Bolts for Cast Iron Pipe and Fittings.
Write for Prices.
H. Y. CARSON
1221 PINSON ST. BIRMINGHAM, ALA.

(Continued from page 116A)

for protection against corrosion, definitions, and sets forth a uniform method of declaring compliance with the standard.

Also included is a brief history of this standardization project, a list of the acceptors, and the membership of the Standing Committee, the chief function of which will be to consider revisions of the standard to keep it abreast of progress in the industry.

Printed copies of Bituminous-Coated Metal Septic Tanks (Single Compartment, Residential), Commercial Standard CS177-51, may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 5 cents per copy. A discount of 25 percent will be allowed on orders for 100 or more copies.

Cemented Wells

1015

Layne & Bowler, Inc., Memphis, Tenn., have made available a folder on **Cemented Wells.** The folder shows in detail, by means of a large 3-page cut-away photo-drawing, the entire well after being cemented. The pump, motor, well casing, screen, surrounding soil and gravel wall are shown.

Photographs of Layne crews in the process of cementing a well are shown, as well as a discussion, complete with sketches, on purity of water insurance.

Rubber Faced Fire Hydrant

1016

Eddy Valve Company, Waterford, New York, has available an information sheet on the company's **Rubber Faced Fire Hydrant.** The sheet discusses in detail the operation of

(Continued on page 120A)

2—New 400 H.P. WESTINGHOUSE MOTORS in original crates. Vertical pump motors. 2200 volt 3 phase 60 cycle 708 RPM. Weatherproof construction including thermoguards. Motors have tapered roller-type anti-friction thrust bearings and are self cooled. Can save you money on these motors.

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(X-754)

Write Today for 66 Page Catalog
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STOP WATER SEEPAGE SEWAGE CORROSION

WITH FORMULA No. 640

a clear liquid penetrating (1"+) sealer for concrete and masonry preventing water absorption and reducing the action of acids. Holds 12' hydrostatic head. Use our Hayproc Rubberized Enamel for color on walls and floors—not affected by concentrated acids, alcohol, oil, or traffic abrasion.

30 OTHER PRODUCTS
Write for technical data.

Haynes Products Co., Omaha 3, Nebr.
See our file in Sweet's

Phipps & Bird
LABORATORY MIXER

IS the important piece of equipment in the Modern Water Works Laboratory. Now being used by leaders in water works research. Many superintendents and chemists have been able to reduce their chemical costs by the control of chemical dosages with this mixer. Write for literature.

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Detailed Specifications and suggested Installation Drawings furnished

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85% OF AMERICA'S MEDIUM CITIES

70% OF AMERICA'S SMALL CITIES

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Since we started *"getting the men out of the sewer holes"*... eliminating hard digging and unsanitary working conditions 18 years ago..."**FLEXIBLES**" have saved many a man's life and greatly improved both sanitary and sewer pipe protection! You cannot afford to be without "**FLEXIBLES!**"

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Nation Wide Service—33 Years Experience

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By welding seams, pits and rivets which gives a riveted tank 15% more Safety Factor than it had when built. No rivets removed, water supply maintained while work is in progress. On completely reconditioned jobs, the painting is guaranteed for five years, repairs guaranteed for ten years, provided the tank is painted every five years by Dixie Tank and Bridge Company. Yearly inspection, making all adjustments, if any, without additional cost.

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SOUND PRINCIPLES OF WATER TANK MAINTENANCE and TANK TALK, by W. A. RILEY

Dixie's Nation Wide Service Satisfies

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THE LARGEST ORGANIZATION OF ITS KIND GIVING SAFE MAINTENANCE AT LOW COST

(*Continued from page* 118A)

the hydrant, and each individual part of the hydrant is fully explained. A cutaway drawing with explanatory symbols illustrates the text.

The opposite side of this information sheet discusses the Eddy Taper Seat Double Gate Valve complete with a cut-away sectional view drawing.

Meter Parts

1017

Fred W. Hanks Company, Cleveland, Ohio, has published a **Price List and Catalog of Discs and Parts** for water meters. In addition to the Company's own "Nowarp" Disc, parts are listed for American and Niagara; Artic; Badger; Empire; Federal; Gamon; Hersey; Keystone; King; Lambert; Nash; Trident; Tropic; and Worthington meters.

Repair parts and gauges are also listed.

Valves and Hydrants

1018

Iowa Valve Company, Des Moines, Iowa, has released a folder on **Iowa Valves and Hydrants**. The bulletin shows a number of the leading items manufactured by the company including: Tapping Sleeves and Valves; Check Valves; Flap Valves, Plug, Drain or Mud Valves; Shear and Sluice Gates; Motor & Hydraulically Operated Valves; Square Bottom Valves; and the "Corey Type Hydrant".

Photographs of each piece of equipment along with cut-away views of the hydrant are also included in the bulletin.

Ion Exchangers

1019

Permutit Company, New York, N.Y., has available a bulletin on **Permutit Ion Exchangers.** The bulletin gives the history of the development of synthetic zeolite or ion exchanger by the company from 1912 to date and lists all types of ion exchangers, both organic and inorganic, developed by Permutit.

A discussion on the selection of the proper ion exchanger covers both Cation and Anion Exchangers. Photographs and diagrams of various applications and installations complete the bulletin.

CMP Record Keeping Plan

1020

Remington Rand Inc., New York, N.Y., has made available a new booklet containing the answers to many record keeping problems facing manufacturers operating under the **Controlled Materials Plan.**

This practical manual outlines methods for simplifying paper work by laying the groundwork for getting the desired result, and shows dozens of ways to save on clerical routine, as well as incorporating information necessary for the correct set-up of records required for efficient operation under CMP regulations.

Basic principles for controlling receipts of raw materials and parts in compliance with CMP Reg. #2 on inventory control are outlined. Advice is included on how to store and protect supporting records on all CMP transactions, as required by law.

Fluoridators

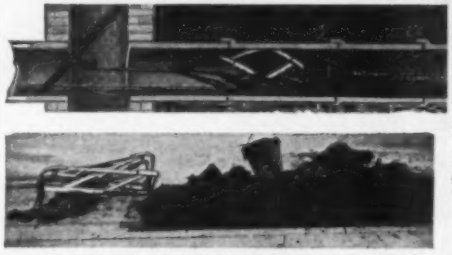
1021

Wallace & Tiernan, Newark, New Jersey, has published a bulletin on **Fluoridators** covering both solution feed and dry feed types.

Step by step operations of the solution feeders are discussed with recommendations for different types of installations. Construction details, advantages and flexibility of the

GATE OPERATORS — PORTABLE — FOR STANDS & UNDERGROUND GATES—MOTOR TRUCK MOUNTED
PAYNE DEAN & CO.
CLINTON, CONN.

EXPANDING ROOT CUTTER & SEWER CLEANER



Open and in action removing roots and caked sediment like this.

It Fits in on Every Sewer Cleaning Job
Adjusted in 30 seconds to fit any sewer from 8 to 30 inches.
Will clean the entire sewer wall, top, and sides as well as the bottom, cutting and removing the roots and caked sediment, putting the sewer system in almost 100% clean condition.
Write for our new catalog on complete sewer cleaning equipment.
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DEPENDABLE JOINTING COMPOUND
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4	2.5	2.00	2.25	8.56
6	2.5	3.00	2.25	11.71
8	2.5	4.00	2.25	14.63
10	2.5	5.00	2.25	17.70
12	2.5	6.00	2.25	20.86
14	2.5	7.00	2.25	24.02
16	2.5	8.25	2.25	33.07
18	2.5	9.25	2.25	36.88
20	2.5	10.50	2.25	40.71
24	2.5	13.00	2.50	53.02
30	2.75	16.00	2.50	65.36
36	2.75	19.00	2.50	77.96
48	3.50	30.00	5.00	121.15
54	4.0	38.00	3.00	135.60
60	4.0	42.00	3.00	150.70

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W&T dry feed fluoridators are covered along with a discussion on the Merchen Weigh-Feed Fluridator.

Installation, dimensional drawings and photographs of the units are shown. The back page of the bulletin shows Technical Data on the fluoridators.

Fluoridation

1022

Wallace & Tiernan, Newark, New Jersey, has just published a 4-page bulletin on **Fluoridation.**

This bulletin covers the complete story on fluoridation, giving the Development of Fluoridation; the amount of fluorine needed; the chemicals used for fluoridation; the feeding of fluorides; the testing for fluorine and points of application.

An interesting feature of the bulletin is the Glossary of Fluoridation Terms which appears on the back page.

"Payloader" Literature

1023

The Frank G. Hough Co., Libertyville, Ill., has just published a comprehensive, 12-page catalog which will prove interesting and helpful to Contractors, Public Works Departments, Utilities, Mines and Pits. Entitled **"Profitable Construction with PAY-LOADERS"** this literature is filled with on-the-job photos showing a wide variety of earth-moving, material-handling, lifting and carrying jobs being performed by these multi-purpose tractor-shovels. Helpful job data, specifications and features of the complete line of earth moving equipment are included.

Controlled Volume Pumps

1024

An illustrated, 24-page, 2-color bulletin on controlled volume pumping and Milton Roy **Controlled Volume Pumps** has recently been published by Milton Roy Co., Philadelphia 18. This bulletin will be of interest to industrial

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plants whose operations call for pumping a controlled volume of liquid in amounts as much as 50 gallons per *minute* or as little as 3 milliliters per *hour*.

The bulletin contains details on controlled volume pumping, describes the features of these pumps and includes data required for selecting pumps for specific applications. Uses are given for these pumps in the chemical, textile, petroleum, food and beverage, water treatment, pulp and paper, paint, pharmaceutical, and brewing industries and in instrumentation, pilot plants, and laboratories.

Water and Sewage Works Equipment

1025

Walker Process Equipment, Inc., has available recent technical information which, for the most part, supersedes previous information included in their Manual.

A new tan colored INDEX sheet replaces the older rust colored previous sheet. The new sheet regroups the interlocking sections into a more logical and handy arrangement.

A new bulletin G50 is a Product Classification and replaces the old "Product Classification and Index Bulletin S1000" and the old "Mixer-Classification Bulletin 4S39."

pH Measurement & Control

1026

Bristol Company, Waterbury, Conn., has just published a new 24-page bulletin on **Automatic, Continuous Measurement and Control of pH.**

The new bulletin describes Bristol's full line of recording and controlling instruments for pH, including the Bristol Electronic Dynamaster Strip-Chart Instrument. Complete specifications are given on glass and calomel electrodes in several different models for both immersion and flow uses.

Illustations and descriptions of a number of applications of the pH instruments for water treatment, sewage and industrial waste treatment, and in the chemical, petroleum, paper, textile, and metals industries are also included.

Fisher's New Washington Plant

1027

Fisher Scientific Company, Pittsburgh, Pa., has just made available a sixteen page booklet describing the new **Washington Plant,** located at Silver Spring, Maryland.

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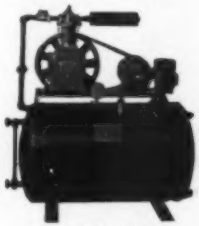

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The booklet is attractively printed in two colors and profusely illustrated with views of the new plant as well as the company's manufacturing units in Pittsburgh, Edgewater, N.J. and New York City.

The Washington Plant was built by Fisher Scientific Company in 1950 and was opened for business at about the beginning of 1951. The booklet, now being offered for the first time, emphasizes the facilities built into the new plant for fast, convenient handling of orders for the company's customers in the Washington area and throughout the Southeast.

Copper Corrosion Resistance Study

1028

American Brass Company, Waterbury, Conn., has just published a booklet entitled **"Corrosion Resistance of Copper and Copper Alloys."**

This booklet contains the results of 25 years study by the American Brass Company's technical staff, both in the laboratory and in the field, of the nature of corrosive attack on copper and copper alloys.

The publication, first of its type in the industry, explains the chemical and physical nature of corrosive attack in its various forms. Included is a tabulation indicating the relative corrosion resistance of the principal types of copper and copper base alloys when in contact with 183 different corroding agents. Photographs illustrate various types of corrosion.

Chlorination of Sewage and Industrial Wastes

1029

The Federation of Sewage and Industrial Wastes Associations, Champaign, Ill., has just made available a 90 page **Manual of Practice No. 4, "Chlorination of Sewage and Industrial Wastes."**

This fourth of the standard numbered series of FSIWA Manuals of Practice, reviews the history, development, and up-to-date technique of chlorine application in all aspects of the treatment and disposal of waterborne wastes. It also includes a selected classified bibliography of more than 350 references.

The Manual is available at $1.00 per copy to members of the association and $1.25 per copy to nonmembers. A discount of 15% is allowed on orders for 12 copies or more. Orders or inquiries should be addressed to the Federation of Sewage & Industrial Wastes Ass'ns., 325 Illinois Bldg., Champaign, Ill.

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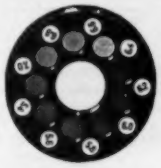

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Pike Hoffman Control Co., Inc. ... 122A
Pittsburgh Coke & Chemical Co. ... 106A
*Pittsburgh-Des Moines Steel Co. ... 25A
Process Engineers, Inc. ... 48A
*Proportioneers, Inc. ... 100A

R
*R-S Products Corp. ... 30A
Roberts Filter Mfg. Co. ... 121A
Rockwell Mfg. Co. ... 3A
Roots-Connersville Blower Corp. ... 113A
Royer Foundry & Machine ... 108A

S
Saran Lined Pipe Co. ... 111A
*Simplex Valve & Meter Co. ... 103A
Smith Mfg. Co., A. P. ... 34A
Smith Co., S. Morgan ... 32A
Sonken-Galamba Corp. ... 118A

T
Taylor Co., W. A. ... 122A

U
U. S. Electrical Motors, Inc. ... 96A
*U. S. Pipe & Fdry. Co. ... 15A

V
*Valve & Primer ... 122A

W
*Wallace & Tiernan Co., Inc. ... 7A, Back Cover
Warren Foundry & Pipe Corp. ... 98A
Wilkinson Products Co. ... 122A
Wood & Co., R. D. ... 104A
Worthington Pump & Mchy. Corp., Water Treatment Div. ... 29A
Worthington Pump & Mchy. Corp. ... 46A

Check these DORRCO DISTRIBUTOR features

against high-rate trickling filter requirements

Distributors for high-rate trickling filters have to be *mechanically* right to handle heavy loadings. Check these mechanical features of the Dorrco Distributor against those of other units...

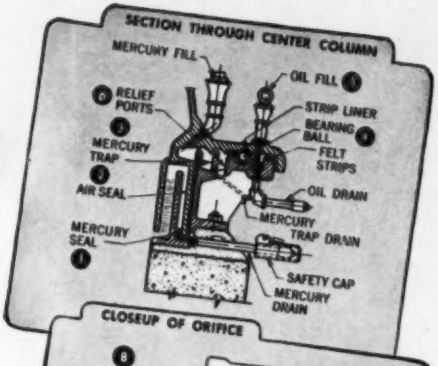
MERCURY SEAL...between rotating and fixed element (1) . . . is protected from contact with sewage by a positive air seal (2). In case of excess surge of pressure sufficient to blow the seal, the mercury is caught in an annular drain trap (3).

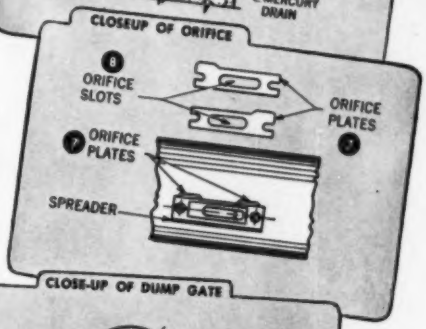
BEARINGS...Large diameter ball bearing race (4) running in oil at *base* of turntable for stability . . . is easily lubricated (5). Relief ports (6), provided for emergency overflow, prevent flooding of bearings under any circumstances.

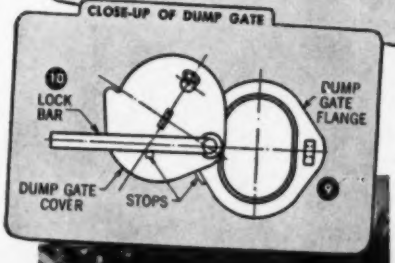
ADJUSTABLE ORIFICE PLATES...Two separate sliding plates (7) are bolted one upon the other to permit final flow adjustments. Orifice slots (8) are elongated to minimize clogging.

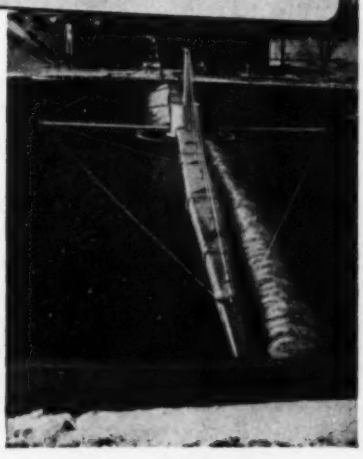
QUICK-OPENING DUMP GATE...provided at the end of each arm (9) is opened and closed easily by means of the lock bar (10).

Dorrco Distributors are available with two or four arms . . . having one or two compartments. On heavy duty units, the arms are of fabricated steel plate . . . tapered for better hydraulic performance and more uniform distribution. ***The sum total of all these points is smooth Dorrco Distributor performance under the most severe of operating conditions.***









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